Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, OCTOBER 14, 1905. No. 16.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE.....1139 Monadnock Block
PHILADELPHIA OFFICE.....929 Chestnut Street
CLEVELAND OFFICE.....402 Cuyahoga Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico.....Per year, $3.00
Foreign Countries, within the Postal Union.....$6.00
Great Britain and Ireland.....25 shillings
Germany.....25 marks
France.....31 francs
Single copies.....10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen moths from date of issue, except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for* 1905 *to date,* **566,500.**

NEW YORK, SATURDAY, OCTOBER 14, 1905.

CONTENTS.

Editorial 637
New York Fire Alarm Service..... 640
The United States Independent Telephone Company..... 640
An Investigation of Municipal Ownership..... 641
Completion of Another Atlantic Cable..... 642
Electric Railway Development in Holland..... 642
Convention of the Illinois State Electric Association..... 643
Electric Power in India..... 645
Convention of the Western Association of Electrical Inspectors..... 646
Indiana Independent Telephone Association..... 646
Water Falls in Egypt..... 646
Current News and Notes..... 646
Electrical Engineers of the Times.—XXXI. Charles H. Hines..... 648
Electric Power on the Blackstone River, Mass..... 649
Central Station Management..... 650
District Electrical Supply..... 651
The Design of Multiple-Coil Windings. By Charles R. Underhill..... 652
Rise of Niagara Power..... 654
Overhead vs. Underground Central Station Circuits..... 656
The Graphitized Filament Incandescent Lamp..... 657
New Telephone Patents..... 658
LETTER TO THE EDITORS:
Approximations of the B. & S. Gauge. By W. F. White..... 658
Digest of Current Electrical Literature..... 659
Book Reviews..... 663
Methods of Charging for Current Supply to Incandescent Lamps..... 665
Single-Phase Railway for Spokane..... 666
Electrically-Driven Pumps..... 667
Guy Anchor..... 668
Hartford Time Switches..... 668
The American Electrical Salesmen Association Organized..... 668
Industrial and Commercial News..... 669
General News of the Week..... 672

THE NEW YORK CITY FIRE ALARM SERVICE.

Elsewhere we print an abstract of a report by Mr. Kempster B. Miller on the fire alarm service of the Borough of Manhattan, New York City, which is startling in its arraignment of the existing system. Scarcely a single detail escapes scathing criticism, and in summing up, the system is pronounced fundamentally wrong in design, not constructed in accordance with any proper engineering plans and in physical condition so bad as to be practically in an advanced stage of decay, and liable at any time to failures rendering it wholly useless in time of greatest need. That such a situation should have been permitted to develop by the city authorities, who have never been niggardly in their appropriations for fire service, and allowed to exist under the very eyes of the technical insurance bureaus centralized in New York, is simply astonishing. Indeed, after reading the sweeping general charges and the flat condemnation of almost every detail of the present system, many will perhaps lay down the report with a feeling that the situation, while perhaps unsatisfactory, has been intemperately exaggerated. The standing, however, of the author of the report, its unqualified approval by the several underwriters' committees having cognizance of the investigation and by the committees' consulting engineer, Mr. John J. Carty, together with the array of data in the appendices justifying the strictures made, are confirmation that the report is but a revelation of an astonishing condition. But Mr. Miller does not deal wholly in denunciation. In the concluding portion of the report he offers as a substitute for the present defective system another which is worked out to insure absolute reliability of service, and in every electrical and engineering detail is thoroughly up to date. As the fire alarm service of many American cities has probably been modeled after that in New York, or has similarly been allowed to deteriorate, the report of Mr. Miller is of national interest, the action, therefore, upon the proposed new fire alarm system by the New York City authorities will be awaited all over the country with impatience by those interested.

THE ILLINOIS STATE ELECTRICAL CONVENTION.

The convention held last week by the electric light men of Illinois was by far the most successful of the kind in the history of the Illinois State Electric Association. The members of this association have been brought together more closely than ever during the past year on account of the action of the State Legislature in placing it within the power of city councils to regulate electric light and gas rates. The unpleasant experiences of last spring, however, were but lightly touched upon at the recent convention, which was devoted entirely to a discussion of business and engineering questions. The Illinois conventions in the past have hardly been up to what might be reasonably expected of an organization of this kind in a state which has the largest number of central station lighting companies of any state in the Union. The convention last week, however, was so far in advance of all its predecessors as to mark a new era in the history of the association, and place it in a rank where it belongs among the State Associations. It is perhaps more difficult to conduct successfully an association of this kind in a state like Illinois with extremely large and extremely small companies, than it would be in a State where there are not such great extremes. At the Illinois convention there were representatives from companies operating in all sizes of communities,

from those in Chicago with its two million population to those from towns of twelve to fifteen hundred inhabitants.

One of the most interesting developments taken up by this convention was that of supplying electric light and power from a central station in some large town to smaller villages from five to sixteen miles distant. It is quite true, as one speaker remarked, that there is seldom any good reason for maintaining two small central stations in towns that distance apart. There is still less reason for building a new central station in a small town when power can economically obtained from some neighboring large station. The transmission of power to suburban communities around large cities in this way has been developing for some time. Equal progress has not been made in the rural districts, although the reports from Illinois show that the new development has reached a number of places and undoubtedly there will be much extension in the next few years. Transmission lines of this kind will not bear very expensive construction because the total profits to be obtained from electric lighting of a village of seven to twelve hundred inhabitants will not pay interest on a very large investment; and it will surprise the engineer who has never figured upon it to see how soon the cost of a transmission line will equal that of establishing a small central station in the village to which it is proposed to transmit current. This is no argument against the practice, but is mentioned simply to indicate what careful figuring should be done before a move of this kind is made. Then, too, there is the question of farmers' service from such lines and how far it will pay to go into that class of work. Altogether there is much of vital interest to the small stations as well as the large ones in this subject. District electrical supply has been extensively practiced in various parts of Europe, and the experience there has pointed to the gradual extinction of the small generating plant, and the supply of large areas from a single generating station. Where the movement has started in this country, as in northern New Jersey, scores of small plants have been closed down, their former distributing system being fed from a central generating plant. This development, which may at any time spread with great rapidity, is one of serious concern to the smaller central stations, and should have their closest attention.

HARMONICS IN THREE-PHASE SYSTEMS.

A fascinating series of oscillographic records of current and voltage on the three-phase distribution system of Newcastle, England, are published in the June number of the *Transactions* of the Institution of Electrical Engineers by Dr. W. M. Thornton. Several moot points are elucidated by a study of these oscillographs. It is shown, for example, that the current and pressure are practically in phase when an alternator is operated entirely on a water-rheostat load. This fact had, indeed, been predicted and asserted from theoretical considerations at various times; but in this case the experimental demonstration is offered. Some have supposed that the electrolytic capacity of the water tanks might cause the current to lead the impressed e.m.f. by an appreciable angle. An analysis of the conditions ordinarily presented shows, however, that this capacity effect is very small. Consequently, we now have experimental evidence to show that the power-factor of a water load is practically one hundred per cent. Another valuable observation described is a simple stroboscopic method of observing the phase shifting of a synchronous motor. A signal or mark of white paint is made on some salient point of the rotor of the synchronous motor to be examined. The machine is then illumined by an arc lamp operated from the same alternating-current supply mains. A small auxiliary synchronous motor of the fan-motor type carries a disk with a suitable radial slot, and the paint mark on the working motor is observed through the slot when both motors are running. Under steady load, the paint mark appears stationary in space; but if the motor load is varied, the paint mark shifts its angular position in space. The shift is not made aperiodically or in a dead-beat manner, but in a series of diminishing swings, lasting for about half a minute. Similar observations may be made when the excitation of the working motor is varied. This stroboscopic method of observation should be both useful and instructive.

LAMP EFFICIENCIES.

Our comments a few weeks ago upon this subject seem to have raised the usual comments and the appropriate rejoinders. Every time the question of rating comes up the same old chaff is threshed out. When all the arguments are summed up one comes by however circuitous a route back to the same old question as to what one really means by efficiency. And we are going here, Yankee fashion, to answer it by asking another. Do we mean by efficiency the quantity of light given by the expenditure of a given unit of energy, or do we mean the conception of each manufacturer as to the relative market value of his product? If the former, then there is but one possible criterion that can logically be applied; i. e., the amount of the total luminous flux for a given expenditure of energy. If the latter, for each value as quoted there are offered as many reducing coefficients as there are sellers of rival lamps. The amount of total luminous flux is correctly measured by the mean spherical candle-power of the illuminant and in no other way. This figure determines once for all the whole available light given out which can be employed in any way the user wishes—allowed to scatter as it will, concentrated in any given direction, or blocked off altogether.

The objections raised against rating by mean spherical candle-power are substantially two: First, that certain illuminants do not readily lend themselves to such measurement; and second, that light given in certain directions is wasted and ought not to be counted. Let us consider these contentions a bit. Now at the start we freely admit that a mean spherical measurement is always more difficult to make than a unidirectional measurement. The only sense in which certain illuminants do not lend themselves to mean spherical measurement is in having certain directions in which they are nearly non-luminous, and the only practical question is whether they should, therefore, be credited with a higher efficiency than they really possess. If they fail to give light in certain directions the deficit of illumination must be made up, if illumination is wanted, from another source. A light, for example, that gives all its radiation in a single hemisphere, will not make so good a showing in mean spherical candle-power as if it gave the same maximum in the shaded hemisphere as well; but, on the other hand, it gives less actual illumination and does not deserve to be credited with what it does not possess. Furthermore, it is not penalized in the least by mean spherical candle-power measurement, since, however, its rating works out, it is credited with all the light that it actually does give. The milk in the cocoanut is just this, that each purveyor of illuminants tacitly demands that his total luminous flux should be measured by its maximum value, in a certain direction by him prescribed. This is a not unnatural attitude and should be taken quite good-naturedly as part of the game —but not too seriously.

The other contention that light in certain directions is wasted and should not be counted is broadly and generally sheer non-

sense. In the first place, in illumination as ordinarily carried out, each point receives light from several sources, thus utilizing the flux in various directions, and also by diffuse reflection in which still other flux takes part. The diffused illumination is often more important than the direct, and in entirely diffused lighting—really the most beautiful form of illumination—the direction of the initial light is of very little consequence. Second, if, as sometimes happens, strong direct illumination in a particular direction is wished, it can be easily and economically secured by the use of a proper shade or reflector. To test the sincerity of this objection based upon directed illumination it is only necessary to put the objector squarely upon record as to whether in rating his particular light on its maximum flux he is perfectly willing to let the other fellow fit his lamp with a first-class reflector and figure the efficiency along the beam. And again, the usefulness of a lopsided luminous flux depends on how it is directed, and one can just as well direct a symmetrical flux with a reflector as juggle the axis of the illuminant. In point of fact, we think that the importance of the natural distribution of luminous flux about the radiant is very much exaggerated. The significant practical differences between illuminants are those depending on color and on intrinsic brilliancy. Let us come to the total magnitude of the light furnished, by measuring the whole of it, and then take up these really important differences on their merits. They give room enough for all the "taking points" needed in the prosecution of business without confusing the prior issue of luminous efficiency. Under present conditions, as witness discussions at meetings of the smaller electrical associations, the whole matter of lamp efficiencies is under contempt, and lamp manufacturers should welcome the clearing up of a situation under which all claims as to merit are apt to suffer in minds rendered suspicious by entirely conflicting claims and counterclaims made as to efficiency.

Grounding Interior Conduit Sheathings.

The June number of the Transactions of the British Institution of Electrical Engineers publishes a paper read by Mr. W. W. Lackie before the Glasgow local section on the subject of "earthing." This paper sets forth somewhat novel and startling suggestions for house wiring and interior-conduit construction that have considerable interest, not only for the engineer, but also for the general public in Glasgow. The Glasgow electric lighting system is in the hands of the city corporation. The system corresponds to what is sometimes known in the United States as the Edison three-wire system, with 500 volts between outers and 250 volts on each side of the neutral. The neutral is normally grounded at one of the generating stations. Interior conduits are employed in the buildings with metallic sheathings which are both continuously connected and locally grounded. The ground connection is almost universally made through the house water mains. It is stated that during the three years, 1902-1904, inclusive, there were 33 fires in the city of Glasgow due to defective electric-light installations. The total number of installations, connected at the end of that period being 11,000. This represents an average of one fire per annum per thousand installation attributed to defective electric light installations. Expressing the result in terms of the 700,000 8-cp lamps connected, of 33 watts each, there was an average of one fire per annum per 60,000 lamps connected. Of the 33 electrically guilty fires, 15, or almost half, occurred through the melting of lead gas pipes in the buildings, by heavy current leaks through these pipes to ground. Of these, 8 occurred in installations where the iron piping or metal sheathing of the conduits was not properly grounded, and 7 in installations where it was grounded. From this it may be inferred that the grounding of interior conduit sheathings under the practical conditions existing in Glasgow is not a complete safeguard against fires caused by the melting of soft gas-pipes and the kindling of the gas.

It is, we believe, the experience in this country that the grounding of continuous metallic sheathing of interior conduits is a complete protection from fires due to such causes. The reasons for this difference between the experience in America and in Glasgow are, perhaps, firstly, that our gas pipes are almost invariably of iron, a much more difficult fusible substance than soft metal alloy; and secondly, that our three-wire voltages are only one half as great as those existing in Great Britain. The paper contains useful data in various directions. Thus it states that measurements have shown the resistance of the ground between the generating station at Port Dundas and a point in Waterloo Street, distant 1,580 yards therefrom, to be approximately 0.05 ohm. This seems to be an unusually low resistance, although information is meagre concerning such ground-resistances. It corresponds to the resistance of a copper cable of one million circular mils directly connecting the localities, or to a continuous iron return of about 7,000,000 circular mils. It is perhaps not a ground resistance in the strict sense of the term, but is probably the resistance of the buried metallic pipe system, between the two places. At all events, it is evident that with such a ground-return system the current strength which might momentarily flow to ground through a fault in the interior conduit sheathing, under 250 volts pressure, might readily be several hundred amperes, and in particular cases might exceed one thousand amperes.

In view of these conditions, the paper proposes that the sheathing of interior conduits should be carefully kept out of contact with metallic systems in the house construction, and that appropriate sections of the sheathing should then be connected to ground at one point through a resistance of, say, from 3 to 25 ohms, according to local conditions. The object of grounding at one place through a resistance, instead of grounding at many places as thoroughly as possible, is to limit the strength of the momentary current rush to ground if a fault should occur in the conduit. Hitherto we have had two opposing schools in wiring. One has advocated insulating everything. and keeping off the ground. Its doctrines suggested the term groundphobia. The other school has advocated grounding everything in sight and its doctrines have suggested groundmania. In this paper we have a hybrid suggestion of always grounding a little, or gently, through resistance. As the matter appears to us, groundphobia is all very well for systems only employing very low pressures, and nowhere coming into the neighborhood or territory of high-pressure systems. It becomes untenable in the dealing with high-pressure systems entering dwelling houses; or systems that may possibly come into connection with high pressures. In these latter cases, groundmania certainly protects life and person, but it may lead the way to heavy current rushes through faults that may be capable of initiating fires under certain conditions; as, for example, when readily fusible gas-pipes stand in the way. It would seem that from the standpoint of American practice, grounding each installation through a rheostat or rheostats is quite unnecessary and would be a needlessly complicated process; while it is to be hoped that even under such conditions as are reported in Glasgow this complicated addition to house wiring will not be considered necessary. Possibly a little extra resistance in the ground connection at the generating station might serve as a partial substitute; but it is not very easy to make suggestions that are valid for conditions three thousand miles away.

New York Fire Alarm Service.

Last December a committee appointed by the New York Board of Fire Underwriters to investigate the fire alarm service of the Borough of Manhattan and New York City secured the services of Mr. Kempster B. Miller to conduct a technical investigation of that service, with Mr. J. J. Carty acting as consulting engineer. Mr. Miller's report, dated September 12, 1905, has now been printed, occupying 54 large quarto pages and a number of appendices, bringing the total up to 131 pages. Maps to the number of thirteen are bound separately. The report is accompanied by a letter from Mr. J. J. Carty approving the plan submitted by Mr. Miller for establishing a new fire alarm system for Manhattan, and by letters of approval also from the committee of twenty of the National Board of Fire Underwriters and from Mr. J. C. Forsythe, chief inspector of the Electrical Department of the New York Board of Fire Underwriters.

A thorough inspection of the existing system was made by Mr. Miller, including the design, construction and operation of the central office, the system of circuits, the location of fire alarm boxes and signal receiving stations, and numerous electrical tests were made upon the cables and their mechanical condition examined in an exhaustive manner.

The conclusions of Mr. Miller from his investigation are startling. The fire alarm telegraph system of the Borough of Manhattan is reported fundamentally wrong in design. It is not constructed in accordance with any proper engineering plans and its physical condition is so bad that it must be characterized as being in an advanced stage of decay and liable at any time to such failures as to render it wholly useless to the fire fighting department in the time of its greatest need. Faulty in original design and construction, the plant has deteriorated, has been patched and repaired in its various parts as they, from time to time became unworkable; and it is declared that the system long ago reached the stage where it could not be transformed into permanent proper working order by any further patching or even by radical repairs.

As a consequence of this deplorable situation, Mr. Miller considers that the only remedy is to establish a new fire alarm system, separate and distinct from the present one, and when the new system has been established and is in working order that the old one be abandoned and dismantled.

This very severe arraignment of the present condition of the fire alarm system is supported in the appendices by notes showing the present condition of fire alarm cables, manholes and service boxes and other details of the installation, and by the data of tests of cables and a record for a given month of troubles developed in the fire alarm telegraph system. The report proceeds to give in detail a description of the present plant, the various defects existing being pointed out. So antiquated, however, was the system found and so poorly installed that the conclusions following the consideration of each of the numerous details investigated are with scarcely an exception condemnatory, this remark applying also to the auxiliary telephone service.

The second part of the report, consisting of 14 pages, proposes a system to replace the present one. Briefly, Mr. Miller recommends a single fire-proof central office located immediately south of Central Park, the building not to contain any gas pipes or boilers and the floors containing the electrical apparatus and exposed wires to be built at such a height above the ground that there would be no possibility of a flood due to a cloudburst, the breaking of a water main or other cause. It should contain no skylights and precautions should be taken to prevent its injury by falling objects from other structures, as in conflagrations or windstorms. The building should be solely used for the fire alarm central office, and not open to the public, and occupied only by those charged with the duty of operating and maintaining the fire alarm system. The electrical apparatus within the building should be of a fire-proof nature and mounted upon non-combustible supports, no ornamental cabinet work being used. The number of cable approaches should be made as numerous as practicable in order to avoid danger of total interruption. The report then goes into detail concerning feeder cable routes, box circuit arrangement, gong circuit arrangement, box and gong circuit conduit, types of cables and manholes, terminal posts, fire alarm boxes, box location, signaling instruments at the apparatus houses, central office apparatus, and the telephone system.

For fire alarm cables rubber-covered, lead-encased wire is recommended, and for telephone circuits the usual paper-covered, lead-encased twisted cable; it is further recommended, however, that the city shall not operate the telephone service between the central office and the various department houses, but lease the necessary facilities from the telephone company doing business in New York. The system of wire circuits recommended is radically different from the present system and new types of terminal posts and improved form of fire alarm box are recommended. An entirely new kind of central office apparatus is also recommended.

In conclusion, Mr. Miller points out that whereas the fire alarm system of New York City has undergone little change during the past twenty years, during that peroid one improvement after another in American industries has followed so rapidly that it is a common thing to replace serviceable machinery and apparatus on account of the superior efficiency thereby obtained. In New York City the fire alarm telegraph system is in every respect obsolete and is totally inadequate for the service demanded of it, and the recommendations made, notwithstanding that in some respects they are radical, are stated in fact to be as a whole conservative in view of the existing situation. The new construction which is recommended has been so long deferred that there is a real danger that before the remedy can be applied the present defective fire alarm system may be the cause of a great disaster.

Mr. J. J. Carty, in a letter accompanying the report, states that after carefully studying the question he concluded that any plan looking to utilization of any substantial part of the present fire alarm system is impracticable and wholly out of the question. The only alternative, therefore, is the establishment of an entirely new system, and when this is ready for service the present one should be abandoned. Having reached this conclusion, he studied in every detail the plan proposed by Mr. Miller for establishing a new system in Manhattan and found that this plan will in every reasonable manner provide the maximum degree of reliability of operation, the minimum expense for maintenance and that it will in first cost, all things considered, be the most economical one for the City of New York to adopt in place of the defective system now in use. The conclusion of the committee of twenty of the National Board of Fire Underwriters is that the proposed system of Mr. Miller shows sound engineering in all its essential features, including those which are departures from earlier methods, and without hesitation the entire report and its recommendations are endorsed. Mr. J. C. Forsythe, chief inspector of the electrical department of the New York Board of Fire Underwriters, in a letter states that Mr. Miller's recommendations are in line with the best engineering practice, and when carried out will result in giving the borough the protection which its importance certainly deserves, emphasis being placed on that part of Mr. Miller's report urging the necessity of prompt action in the substitution of a new for the old system.

The United States Independent Telephone Company.

Announcement is made of the completion of the permanent organization at Rochester, N. Y., on October 7, of the United States Independent Telephone Company, the incorporation and general plans of which have already been noted in these columns. Mr. Thomas M. Finucane has been elected president of the company and among the directors are such well-known men as Adolphus Busch, Walter B. Duffy, George Eastman, the president of the Eastman Kodak Company; August Gehner, president of the German-American Bank of St. Louis; Robert C. Hall, of the Independent telephone system of Pittsburg; William H. Page, of this city; Hendrick S. Holden, president of the Commercial National Bank of Rochester, and Hiram W. Sibley.

Mr. Finucane states that the company possesses franchise rights in New York City similar to those owned by the Bell Company. The plans of the United States Company are set forth by Mr. Finucane in the following statement printed in the daily press of October 7:

"The formation of the United States Independent Telephone Company is the first step in the movement to furnish telephone companies with standard apparatus and with a guarantee that their supply cannot be cut off through the absorption of manufacturing companies by the Bell interests; to knit together in connecting systems the independent telephone lines of the country, which, un-

appreciated as the fact may be in the East, to-day considerably outnumber the lines owned or controlled by the Bell Telephone Company, and to aid independent telephone companies in the installation of their plants and improvement of their service.

"There are to-day over 5,000 telephone companies in this country independent of the Bell systems. In response to the demand of these companies for product and appliances and for a centralized unity of action, the United States Independent Telephone Company has been incorporated.

"The independent telephone lines represented directly or indirectly by or through one or another of our directors comprise systems which extend substantially from Kansas City, Mo., to New York.

"Our plans have been the subject of consideration for some months. In formulating them we have had conferences with leading lawyers in the cities of New York, St. Louis and Rochester, among them were William H. Page, Jr., Samuel B. Clarke, William C. Trull and Frederick P. Delafield, of New York City; Richard V. Lindabury, of New Jersey, Walter S. Hubbell, of Rochester, and Judge Henry S. Priest, of St. Louis, Mo.

"In result we acquired and now own franchise rights in New York City which, in the opinion of our attorneys, are similar in scope and character to those of the Bell Telephone Company. These we propose to make the subject of the installation of a plant with a present capacity of 225,000 telephones and an ultimate capacity of 750,000 telephones for New York City and the tributary districts which environ it.

"Our company to-day authorized its collateral trust mortgage of $25,000,000, and the underlying securities will comprise a control of the Stromberg-Carlson Telephone Manufacturing Company, which manufactures a thousand telephones a day, and the New York Independent Company, which latter owns the franchise rights above referred to."

Mr. Finucane on Monday of this week made public details concerning the franchise under which the company expects to do business in New York City. The franchise is that granted to the Mercantile Electric Company on June 29, 1894. Papers filed with the Secretary of State and County Clerk on October 7 show that the Mercantile Electric Company was merged into the New York Independent Telephone Company, the stock of which is owned by the United States Independent Telephone Company. Of the franchise Mr. Finucane says:

"The Mercantile company began the construction and operation of its system throughout the subways of the Empire City Subway Company and subsidiary conduits constructed for its own account, which it owns. These cables and wires extend through portions of Broadway, Wall, Cortlandt, Cedar, Pine, Nassau and Broad Streets. The system now centers in 120 Broadway, where its switchboards are located. The appliances of the company have been used in connection with burglar alarm business and are adapted to and have been used for telephone purposes.

"We are required to use the ducts of the subway company unless this restriction is removed by the city. On the other hand, the charter of the subway company requires it to construct subways for us on our putting up a bond to cover the expense of building the conduits applied for and to rent them to us at rates fixed in the subway company's charter.

"Our franchise is an operating property and has been for more than ten years. Its rights to lay wires underground come from the same source and are in the same form as those of the Bell Telephone Company. * * * *

"We are advised by counsel that these two franchises, ours and that of the Bell Company, are the only two existing franchises which give the grantees in terms the express right to use electrical conductors for telegraphic and telephonic business."

Mr. Finucane thinks that his company, in less than two years, will have 225,000 telephones in operation in New York City. He says the citizens of New York and other cities will get the best telephone service they ever had.

The Great Eastern Telephone Company, of New York City, formed to operate in and between the cities of New York, Albany, Syracuse, Rochester, Buffalo and other cities and villages of the State, was incorporated at Albany, October 9. The line will connect with other telephone companies in other parts of the United States and Canada. The company has a capital of $1,000,000. The directors are William H. Schack, Eugene H. Brock, Elias J. Beach, Egbert A. Reynolds, D. A. Reynolds and W. Myron Reynolds, of New York City, and Stephen M. Conger, of Queens Borough, New York.

An Investigation of Municipal Ownership.

Considerable progress has been made by the special committee appointed recently by the executive committee of the National Civic Federation to investigate public ownership and operation of such utilities as gas, water, electric lighting and street railways. A general meeting, which was largely attended by representative men, was held at Earl Hall, Columbia University, New York City, October 5, when in the absence of President August Belmont, the meeting was called to order and addressed by Mr. Samuel Gompers, first vice-president of the Federation. In a letter regretting his absence on account of sickness and an operation, Mr. Belmont said:

"The subject of municipal ownership and operation of public utilities is forcing itself upon the attention of all thoughtful persons. Unfortunately, the very lack of comprehensive and authoritative data and information leaves the discussion to theorists, who often advance arguments which can neither be accepted nor rejected, for the very reason that no authoritative data exist. The National Civic Federation will now try to obtain true and reliable facts to guide the student and legislator in seeking the best means to establish peace and maintain co-operation between capital and labor. To the accomplishment of this purpose I have encouraged this movement and advocated the missions of the sub-committees.

"The relations of capital and labor are vital to the prosperity of the individual and to the State. It is proper, therefore, that arguments should be based on correct facts and known conditions. The Civic Federation has no greater work among its varied duties than to secure these data. The committee, which it purposes to send abroad, represents every shade of thought and opinion on the subject. This committee, when it returns, will report to a larger commission of men at home likewise drawn from every part of the country and representing every phase of life. The Civic Federation has no interests to serve and no arguments to make on the subject, but to present the facts and conditions as they may exist abroad and at home, for the use and benefit of the entire country, without respect to special interests."

The general question was discussed throughout almost the entire day, and it was decided not to take up any of the large questions connected with governmental ownership and operation of steam railways, telegraphs, etc., but to limit the inquiry, at least at this stage, to municipal utilities. There was considerable discussion as to how far even this limited inquiry should go, but a consensus of opinion was manifested as to the subjects mentioned above as being those particularly desirable for study. Special emphasis was laid upon street railways as perhaps the matter that was most deeply interesting to the population of some of the largest American cities at the present time.

Before the close of the day the following officers and committees were elected and appointed:

Officers.—Melville E. Ingalls, president, Big Four Railroad, Cincinnati; John Mitchell, vice-president, president United Mine Workers, Indianapolis, Ind.; John G. Agar, second vice-president, president Reform Club, New York City; Edward A. Moffett, secretary, editor *Bricklayer and Mason*, New York City.

Executive Committee.—The officers ex-officio and Alexander H. Revell, merchant, Chicago, Ill.; E. E. Clark, grand chief Brotherhood of Railway Conductors, Cedar Rapids, Iowa; Isaac N. Seligman, banker, New York; E. Rosewater, editor *The Bee*, Omaha, Neb.; William Wirt Howe, lawyer, New Orleans; Samuel Insull, president Chicago Edison Company, Chicago; John Bancroft Devins, editor New York *Observer*, New York; Frederick N. Judson, attorney, St. Louis, Mo.; Carrol D. Wright, president Clark University, Worcester, Mass.; Hamilton Holt, editor *The Independent*, New York; Walter MacArthur, editor *Coast Seamen's Journal*, San Francisco, Cal.; D. L. Cease, editor *Railroad Trainmen's Journal*, Cleveland, Ohio; Franklin MacVeagh, merchant, Chicago, Ill.; Henry M. Farnam, Yale University, New Haven, Conn.; George H. Harries, Washington Railway & Electric Company, Washington, D. C.; Louis D. Brandies, lawyer, Boston, Mass.; Marcus M. Marks, manufacturer, New York City; James O'Connell, president International Association of Machinists, Washington, D. C.; Lawrence F. Abbott, editor *The Outlook*, New York City; R. R. Bowker, editor *Publishers' Weekly*, New York; Alexander C. Humphrey, president Stevens Institute, Hoboken, N. J.; J. W. Jenks, Cornell University, Ithaca, N. Y.; John Tobin, president Boot and Shoe Workers' Union, Boston; Frank A. Vanderlip, National City Bank, New York City.

Committee on Investigation (to investigate the subject in America and foreign countries).—M. E. Ingalls, Big Four Railroad Company, Cincinnati, Ohio; Talcott Williams, editorial writer, *The Press*, Philadelphia, Pa.; W. D. Mahon, president Amalgamated Association of Street Railway Employes, Detroit, Mich.; Frank J. Goodnow, Columbia University, New York City; Walton Clark, United Gas Improvement Company, Philadelphia, Pa.; Dr. Albert Shaw, editor *Review of Reviews*, New York City; Edward W. Bemis, superintendent water works, Cleveland; John H. Gray, Northwestern University, Chicago, Ill.; Walter L. Fisher, Municipal Voters' League, Chicago, Ill.; Timothy Healy, international president Stationary Firemen, New York City; William J. Clark, General Electric Company, New York City; H. B. F. MacFarland, president Board of Commissioners, District of Columbia, Washington, D. C.; Daniel J. Keefe, president International Longshoremen's Association, Detroit, Mich.; Frank Parsons, president National Ownership League, Boston; John R. Commons, University of Wisconsin, Madison, Wis.; J. W. Sullivan, editor *Garment Workers' Bulletin*, New York; Leo S. Rowe, University of Pennsylvania, Philadelphia; F. J. McNulty, president International Brotherhood of Electrical Workers, Washington, D. C.; Albert E. Winchester, manager South Norwalk Electric Plant, South Norwalk, Conn.; Charles L. Edgar, president the Edison Electric Illuminating Company, Boston, Mass.; Milo H. Maltbie, franchise expert and former editor *Municipal Affairs*, New York City.

At the adjournment of the meeting of the commission, 15 members of the Committee on Investigation met informally to confer upon means for carrying out effectively the purpose of the movement, and a sub-committee of this investigation committee, consisting of Messrs. Goodnow, Walton Clark, Bemis, Sullivan and Maltbie was appointed to prepare a set of questions designed to cover all the vital points on which information is desired in this country and abroad. These questions will be taken up at an early date in November by the larger committee on investigation for such action as may then be deemed advisable. During all the discussions there was a strict avoidance of the polemical aspects of the question and a strenuous insistence upon the desirability of securing by the work of the committee the absolute facts and data irrespective of the interpretation that might subsequently be put upon them. Inquiries will be carried on by the committee, not only in this country but in Europe, it being necessary, for example, to cross the Atlantic to secure figures with regard to municipal street railway operation, there being virtually no roads of that character in the United States. It will be some months before the work of the commission can be completed and brought to public attention.

Completion of Another Atlantic Cable.

Reference was made editorially in these pages last week to the completion of another Atlantic cable. The Commercial Cable Company's fifth cable from Canso, Nova Scotia, to Waterville, Ireland, was put in operation on October 6. This makes seven trans-Atlantic cables worked in direct connection with the lines of the Postal Telegraph Cable Company. All of them are duplexed so that their combined capacity is fourteen messages at one time. The new cable is said to be the best and most expensive submarine cable ever laid. It was manufactured by the Telegraph Construction and Maintenance Company, of London, having been begun in March, 1905, and finished and shipped on board their steamer *Colonia*, on August 3.

Atlantic cables are always laid from west to east because the prevailing winds in the summer months on the Atlantic are from the west, and ships make much better speed going eastward; consequently the *Colonia* sailed direct from England to America, arriving off the coast of Nova Scotia on August 16. She landed the heavy shore end of the cable on the morning of August 18. Moving out from the shore she struck a rock and remained fast on it for four days. The injuries she sustained compelled her to go into drydock at Halifax with 2,300 miles of submarine cable aboard. She was the largest and heaviest ship ever taken on that drydock, exceeding by thousands of tons the United States battleship *Indiana* of ten thousand tons, which went into drydock there a couple of years ago. Repairs were made and the *Colonia* took the seas again. On September 23 she laid her course from Canso, N. S., paying out cable. On September 28 she passed through a hurricane in mid-Atlantic, although on that day the weather on both sides of the Atlantic was reported fine, with gentle winds. On October 3 she arrived without a mishap at a point 187 miles from the coast of Ireland, where the final splice was to be made between the cable that she had paid out from the American side and the 187 miles of cable previously laid westward from the Irish coast by the steamship *Cambria* in the month of June. The weather was heavy and the *Colonia* was compelled to heave to for several days awaiting smoother seas to enable her to make the final splices on October 6.

At some points the cable was laid at a depth of nearly three miles below the surface of the sea. The quantities of material used in the manufacture of the cable were 1,411,200 pounds of copper; 799,688 pounds of gutta percha; 16,845,000 pounds of brass tape, jute, yarn, iron wire and preservative compound. The signaling speed of this cable is fifteen per cent greater than that of any other cable of equal length in the Atlantic. The cost of the cable varied from one thousand dollars to six thousand dollars per mile, according to the character of the ocean bed and depth of water, the great variation in cost being naturally due to the different diameters and weights of the sections of the cable. In the neighborhood of the fishing grounds off the coast of Newfoundland, a type of cable midway between deep water and shore end cable is used. This intermediate size is made strong to resist injuries from the anchors of fishing craft, the most prolific source of danger to submarine cables. This intermediate type is made just heavy enough to afford reasonable prospect of retrieving it in the event of its being damaged by the anchor of a fishing vessel.

Electric Railway Development in Holland.

Attention was called recently in these columns to the Holland-American Construction Company, incorporated under the laws of the State of New York and backed by Westinghouse interests, its object being the construction of the most extensive electric railway system ever projected by Americans in Continental Europe. The scheme provides first for the building of a railroad from the German frontier to the North Sea. Later on it is proposed to build several branches. The western terminus of the proposed line is Wykan Zee, on the shore of the North Sea, about three miles north of the west end of the Amsterdam Canal. The main line is to cross Holland in a southeast direction to Arnheim, about a dozen miles from the German frontier. From Wykan Zee it will run to Zaandam, and thence into Amsterdam, the principal city in Holland. Continuing in approximately the same southerly direction, the main line will cross the canal that connects the Rhine with the Zuyder Zee to Utrecht. From Utrecht the road will cross the lower Rhine Valley to Rhenen, a small town some five miles north of the Rhine, where it will turn slightly north of due east to its terminus in Arnheim. It is said that the system may be extended by the construction of branches so that ultimately the entire lines to be built by the Holland-American Company may aggregate some 250 miles.

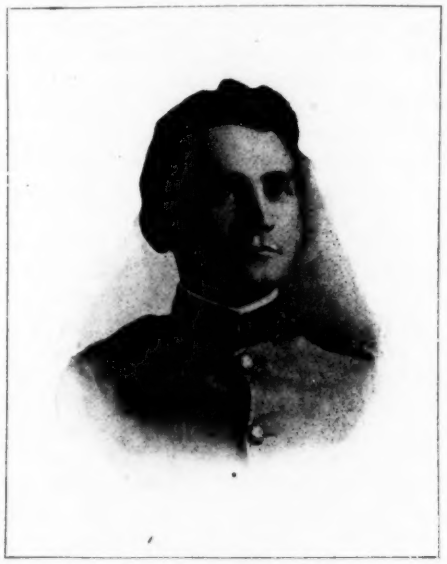
Wykan Zee, the proposed western terminus of the line to be first constructed, is not now in direct land communication with Amsterdam, but from Zaandam to Arnheim the road will practically parallel steam lines already in operation. Both freight and passengers will be carried by the proposed road on its main line and branches. The ballasting of the lines will be in accordance with the best American practice, and the rails will be heavy to permit of high speed. The average speed to be maintained between towns is expected to exceed fifty miles an hour. The road will be constructed on a private right of way, as is necessary under the Dutch laws.

The board of directors of the Holland-American Company includes the names of four Westinghouse men—George C. Smith, vice-president of the Security Investment Company of Pittsburg, of which George Westinghouse is president; Walter D. Updegraff of the same concern, Newcomb Carlton, fourth vice-president of the Westinghouse Electric & Manufacturing Company, who has charge of the financial end of the Westinghouse electric interests in New York and Joseph H. Lukach, a director and financial head of the British Westinghouse Electric & Manufacturing Company, Limited. John F. Alden, at one time prominently connected with the American Bridge Company; J. George Kaelber, Charles H. Palmer, and John H. Beckley, who are also largely concerned in the new company, have sailed for Europe. On reaching the other side, they will be joined by Mr. Lukach, and the whole party will proceed to Holland to look over the carrying out of the enterprise, which will represent an expenditure not far short of $5,000,000.

Convention of the Illinois State Electrical Association.

The Illinois State Electric Association convention held its sixth annual convention at the National Hotel, Peoria, Ill., October 5 and 6, 1905. The attendance was large, the programme exceptionally suited to the character of the membership, and the social features were well selected and excellently carried out. Much of the success of the meeting was due to Mr. David Davis, who as secretary, had charge of the preparations, and his election at the meeting to the presidency was particularly appropriate.

The new president, Mr. David Davis, was born in Litchfield, Illinois, in 1868, where he has lived his entire life. He was educated in the public schools of Litchfield and began his business career in a bank in that city. Gradually working his way up in the banking business he incidentally became secretary of the Litchfield Gas & Electric Company, of which he was later made manager as well. His connection with this company dates back ten years. He was one of the organizers of the Illinois State Electric Association, as the minutes of the first meeting in 1900 show, and served as its treasurer up to a year ago, when he was elected



PRESIDENT DAVID DAVIS.

to the important office of secretary. His work as secretary is best shown by the report of the convention of last week, which was by all means the most successful and profitable ever held by the association. In just recognition of his work he was at that convention elected president. During the Spanish-American war he served with the Fourth Illinois Regiment, and is prominent among the Illinois Spanish war veterans, being last year department commander for Illinois.

President E. B. Hillman, of Quincy, called the first session of the convention to order about 11 a. m. October 5. He made a brief address, saying that the little "roughness" that the members of the association had been treated to the last year had brought them closer together than ever and made them realize the necessity of organization and of pulling together. His reference, of course, was to the rate-making legislation which was passed by the last Illinois legislature.

After some routine business Secretary D. Davis, of Litchfield, read the financial report which showed a balance on hand, including the balance from the previous year, of $188.45. Applications for membership were then received from fifteen companies. A committee was appointed to draw up amendments to the constitution and by-laws to suit some new conditions which are arising. This committee consisted of Mr. H. E. Chubbuck, of Ottawa; Mr. S. S. Davis, of Rock Island, and Mr. F. W. Little, of Peoria.

Mr. J. J. Frey, of Hillsboro, made a suggestion that the association give its secretary a salary and have him collect and distribute information of value to the members. Secretary Davis suggested that this was a work which was already being carried on by the National Electric Light Association better than a state organization could possibly do it, and he suggested that it would be better for companies desiring this kind of service to join the N. E. L. A. rather than to attempt to do this in the state organization. He thought it would be better for the association to continue its work along about the same lines as in the past. Mr. Chubbuck agreed with Mr. Davis as to the association's field. Mr. F. W. Little, of Peoria, said it was impossible for the N. E. L. A. to get information from any of the smaller stations. After some further informal discussion of this question, it seemed to be the consensus of opinion that no change be made in the plan of work of the association. The meeting then adjourned until Thursday afternoon.

Thursday afternoon the session was opened by the reading of a paper on "Underground vs. Overhead Lines," by Mr. H. B. Gear, of the Commonwealth Electric Company, Chicago, which is printed elsewhere in this issue. This paper was intended for the benefit of a number of companies in the larger Illinois towns where underground work is being considered for the business districts.

In the discussion of this paper Mr. R. S. Wallace, of Peoria, inquired as to the depreciation of underground conduits and also how feasible it would be to reach part of the customers through the property of other customers where laterals are put in only at the corners and middle of each block, as indicated in Mr. Gear's paper. Mr. Gear replied that depreciation of a conduit was an unknown quantity. The cement and tile was probably as durable as the earth in which it was placed. This was not true, of course, of the old-fashioned pump-log conduit. The cable should be good for ten years or longer. Some depreciation must be allowed to meet changes in the art. As to customer's service lines, in some cases it would be possible to run iron-pipe conduit along the outside of buildings, to give service from one customer to another. It was contrary to city regulations in Chicago to have the service for one customer to run through another customer's premises, the idea of the city authorities being to keep down the number of wires running in front of or under the sidewalks and in basements of buildings.

Mr. A. V. Schroeder, of Springfield, wished to know if there was any higher rate charged in Chicago in the underground distribution district than where the distribution was overhead. Mr. Gear replied that the only underground conduit work recently done in the Commonwealth Electric Company's district in Chicago, in residence streets, consisted in placing the main feeders underground and making the distribution for the consumers in each block overhead. In any case it is difficult to discriminate in rates between overhead and underground lines.

Mr. Wallace, of Peoria, asked what was done to detect theft of current on secondary lines placed under the sidewalk, and what was the practice in regard to the manhole transformer. Mr. Gear replied that the refusal of the owner of the premises to allow the company to inspect the wires was always taken as a suspicious circumstance calling for further investigation. It is the aim to keep clear of transformers in manholes as far as possible, as, after heavy rains, manholes are likely to be flooded. Where it was necessary to use them, the secondary net-work fed by the underground transformer was separated by fuses from the balance of the network, to prevent a general short-circuit of the secondaries if the transformer was flooded. Mr. G. H. Lukes, of Evanston, asked whether the figure of $1.25 given by Mr. Gear as a cost per lineal foot of four-duct conduit line included manholes for service laterals. Mr. Gear replied that it did not, and said in answer to a further question from Mr. Lukes, that wherever lines could be placed in the alley, the most practical scheme was to run overhead service lines to the buildings in a block from a distributing pole in the alley, having the main feeders underground in the alley. That was undoubtedly the most desirable plan, but it was not always possible to do this in Illinois towns and he had, therefore, in his paper assumed the most difficult case.

Mr. Hillman asked whether, assuming as a hypothetical case, a town of 25,000 population in which an overhead line had depreciated to such a point that it was of no value and it would have to be entirely rebuilt, Mr. Gear would advise the rebuilding with overhead construction or would suggest underground work in the business district. Mr. Gear replied that he would prefer to do all the detail distributing to customers overhead, but that there was much safety in putting the main lines in underground conduit because heavy pole lines are subject to considerable interruption of service from the falling upon them of telegraph and telephone

wires and from chance crosses between the line wires themselves.

The convention then heard the report of the committee on revision of constitution of by-laws, submitted by Mr. F. W. Little, of Peoria. One amendment offered provided that any member company whose property might be sold or leased to a municipality should cease to be a member. Another amendment provided for a closer scrutiny of applications for membership than formerly, and a third amendment provided for four vice-presidents. These amendments were all adopted.

At the request of J. J. Frey, of Hillsboro, chairman of the committee on insurance, the convention gave a few minutes of its time to hearing E. R. Townsend, electrical inspector for the insurance companies of Illinois. Mr. Townsend told how central station construction had improved so that instead of being a very poor class of risk as it was formerly when the old schedule was made it was now one of the best. It was now proposed by the insurance companies to put an expert at work making a survey of all the central station properties of the state, giving suggestions as to the ways in which these risks could be improved so as to secure better rates. The electrical machinery of the present day was not as susceptible to water damage as older machinery. Poor wiring and lack of proper lightning protection was responsible for much of the electrical risk in the older stations. He gave several examples showing how reductions of rates as much as 50 per cent had been obtained by central stations making small improvements. The most important reductions by small changes were usually available on the better class of buildings. He then read the schedules to be adopted by the Western Union of Underwriters.

Mr. Homer E. Niesz, of Chicago, said that he had been working for such a revision of the central-station schedule for a long time, as it had been evident that the old schedule on central-station risks was entirely antiquated and suited to conditions of twenty years ago, rather than to those of to-day. After some further remarks on this matter, the discussion was closed to be taken up on the following day in connection with the report of the insurance committee.

Prof. S. W. Parr, professor of applied chemistry, University of Illinois, read a paper on "Composition and Heating Values of Illinois Coal." The paper at first briefly outlined what the buyer of coal usually wishes to know, first as to the amount of ash it contains, and second, the amount of clinker likely to result from its combustion. He found it true from a long series of investigations that screenings run uniformly higher in ash than lump coal, this being confirmed also by popular observation. There was good reason for this fact when the methods of mining were considered. In Illinois most of the coal is mined with the aid of coal-cutting machines, which cut a space several inches high under the lower part of the vein. These machines, in cutting, produce a large amount of the screenings, and the coal in the lower part of the vein is high in ash. The presence of sulphur was usually taken as an index to the amount of clinker that would form, but such an assumption was not always safe. A better index of the clinkering qualities of the coal would be the amount of sulphur mixed and compounded with iron. Moisture runs higher in slack than in lump coal. It is not, therefore, wonderful that slack or screenings, being high both in ash and in moisture, gives in practice such poor results. Much of the paper was given up to emphasizing by various statistics the point that not all of the volatile matter in coal is combustible as is frequently assumed. This non-combustible volatile matter, while very small in high-grade eastern coal, such as Pocahontas, was high in Illinois coal. Taking all these things into consideration, if we calculate the number of pounds of coal to make 100 pounds of combustible with Pocahontas coal, we find that it will take from 104 to 109 pounds of coal, while with Illinois coal it will take from 119 to 141 pounds of coal, and with lignite coal, from 120 to 162 pounds of coal. The effect of such difference in coal upon a boiler steaming capacity is very apparent. He then classified the different veins of coal being mined in Illinois, giving the characteristics of each. In the discussion which followed, in answer to a question as to the form in which the non-combustible, volatile matter appears in the flue gases, he said that they appeared as steam. There was no doubt that some coals lose, by standing, their volatile gases more readily than others.

A paper on "Interurban Transmission" was read by Mr. W. R. Pinckard, of Chicago, which is printed on page 651 of this issue. In the discussion following this paper it became apparent that such lines had been built in several places in Illinois with marked success. Mr. Lukes, of Evanston, asked whether Mr. Pinckard would advocate the placing of both lightning arresters and transformers on a pole on a 16,000-volt transmission such as he outlined. Mr. Pinckard replied that with such a voltage he would place them in a house. Mr. Lukes raised another question as to whether a company building such a transmission line could afford to jeopardize the whole service by attempting to distribute power to various small users along the way, the income from which would be small. This question had come up with his company, and it was a serious one. Mr. J. J. Frey, of Hillsboro, whose company has operated such an interurban transmission some time and is about to start another one, said that this question of how far to cater to small users along the way was also a very serious one with them. They had a number of such on the line. Mr. E. L. Brown, of Elmwood, who has such a line, reported that he had many farmers on the line and had found the business very satisfactory. He made it a practice to set the transformers on short stub poles.

Mr. Gear, of Chicago, spoke of two 9-mile transmission lines to suburban towns which his company operated. These lines have a voltage of 8,800, and at the various suburban towns where current is required, step-down transformers giving 2,200-volt secondary current are placed on short poles, and the distribution over each town made at 2,200 volts, as in standard practice. There was no reason why two small plants should be operated within eight or ten miles of each other. President Hillman expressed the opinion that such interurban lines must come inevitably in order that the lighting of small villages might be accomplished economically. He thought there would be much development along this line.

Mr. Frey, of Hillsboro, in answer to further questions, said he had a transmission line 16 miles in length, operating at 16,500 volts. The cost of the line was about $6,000 per mile. He had secured a franchise for the pole line. Mr. Frank J. Baker, of the North Shore Electric Company, operating in the suburban districts near Chicago, said that his experience had convinced him that it was best by all means to secure a private right-of-way, as it was easier and less expensive than to secure a franchise. In Illinois such franchises require, first, the permission of all the property owners, and such permission in proper legal form is difficult and sometimes almost impossible to secure. A private right-of-way could often be purchased for less total expense. His company had several such lines and is building more.

A well-attended session was held Thursday evening, at which time Mr. F. W. Willcox, of the General Electric Company, read a paper on the new graphitized carbon filament incandescent lamps. The question of increasing the efficiency of incandescent lamps can, he said, mainly be accomplished in two ways: First, by a more intelligent use of reflectors and the proper placing of the lamps; and, second, by improvement in the filament, both of which characterize the new General Electric high efficiency lamp. Moreover, there is reason to expect an even greater increase in efficiency with low-voltage heavy filament lamps by the introduction of this new filament than in the lamps of higher voltages with smaller filaments.

Mr. Niesz, of Chicago, expressed the opinion that while the increase in efficiency may be equivalent to a reduction in rates for current, a reduction in rates does not mean a reduction in income. The cheapening of light means that more will be used and the business will be greater in the long run. In general, looking at the matter in a broad way, it is to the interests of the central station companies to introduce improvements as fast as they come out. He spoke positively and at length on these points.

Then followed a very long and animated discussion of the question of free lamp renewals. Although the majority of the memmers, especially of the larger companies, practice and favor free lamp renewals for customers, there were a number of officers of smaller companies present who did not believe it a proper policy for small companies. Mr. Willcox called attention to the fact that all the larger central stations of the country considered it one of the essential things in the business to renew lamps without cost for customers, in order to keep up the efficiency of the service, and that if the company did not furnish free lamp renewals, the customers would purchase the cheapest and most inefficient lamps they could get. Such lamps would remain on the circuit until they were unfit to be used, but the customers would never

renew them until they were burned out. The results would be that the customers would be paying a high price for the light secured and the poor lamps would stand in the way of the giving of good service by the central-station company. The central-station company was making every effort to improve the efficiency of its apparatus all along the line and it was a serious mistake to allow the customer to stand between the company and good results with poor lamps. Some of the representatives of smaller companies persisted that they could not see why it was necessary to assume the expense of free renewals. Mr. Frank J. Baker then stated that he did not formerly believe in free lamp renewals until he had experience with a company where customers purchased their own lamps. The 16-cp lamps on the circuit were found to be consuming from 70 to 80 watts, and were being purchased at a Chicago department store. The only thing that stood in the way of large customer's bills was the fact that at the same time many of the meters were running slow. In order to weed out these low-efficiency lamps, when the meters were overhauled the practice was adopted of retailing the best high efficiency lamps at customers at 10 cents each, which effectually prevented the further use of poor lamps. One of the greatest objections to not furnishing free renewals was that frequently in a house one-third of the sockets would be out of use because of burned out lamps through the neglect of customers to purchase new lamps.

Mr. Gear described the practice of the Chicago companies in following up complaints of customers as to poor light. The first point investigated was as to whether a consumer was receiving proper voltage. Being assured on this point, the inspector would examine the customer's lamps as to dirt, inefficient globes and reflectors and other matters likely to cause poor results. Finally, if lamps were getting dim, they were replaced and the old lamps returned to the company. Lamps not burned out were tested as to candlepower and if found reasonably near initial efficiency, would be cleaned, packed up and sent out again. Many of these older lamps were used for supplying customers' demands for colored lamps by the dipping process. It was found, however, that only 10 per cent of the unburned lamps coming in under such a policy were good enough to send out again.

Mr. C. A. Vallette, of Edwardsville, still maintained that free lamp renewals were beyond the small company. Mr. H. E. Chubbuck, of LaSalle, asked why the compromise of selling the customer a good lamp at less than the cost of a poor one was not a good one for the small company. Mr. R. A. McLaughlin, of Galesburg, told how in Galesburg eighteen months ago customers' sockets were filled with inefficient lamps purchased mainly from hardware stores. The company adopted the policy of advertising lamps at 15 cents each, or less than the hardware stores could afford to sell them. The company now has the business of furnishing lamps to its own customers.

Mr. Willcox pointed out that this compromise of furnishing lamps at cost or less was better than no attempt to regulate the matter, but that if the companies sold high-efficiency lamps which would burn out in 400 hours or less, the customer would be dissatisfied at the short life of the lamp and might complain that the company was trying to get the better of him by selling poor lamps. Since lamp renewals were so small in proportion of the total expense in any event, why stop half way? Why not go the whole distance and keep customers satisfied by giving them first class service and renewing lamps free of charge? A number of smaller companies reported furnishing free renewals and much in favor of this practice. The discussion, although on a subject which is accepted as a matter of course by a majority of the larger companies of the country, was nevertheless both interesting and amusing; so much so, in fact, that those in attendance did not realize the lateness of the hour until the president announced that it was time to adjourn, at 10:40 p. m. The Illinois Association is not without its humorists and these had full swing in this lamp renewal discussion.

The president appointed as a nominating committee, Mr. X. Caverno, of Kewanee, Mr. R. S. Wallace, of Peoria, and Mr. R. H. Abbott, of Petersburg.

Friday morning the committee on insurance, consisting of Mr. J. J. Frey, of Hillsboro, and W. A. Thomas, of Abington, made its report. This committee found at the beginning of its work that there had been no new schedules for central-station risks for the past ten years. He found further that the members who had responded to the committee's inquiry had paid in premiums in the past five years, $124,105, and received in payment for fire losses $3,911. Out of the 99 companies, members of the association, 45 of those that replied carried insurance and 30 did not. The committee armed with these figures went to the insurance authorities, with the result that Mr. Townsend, who spoke the day before, had been appointed electrical inspector to investigate the matter and changes were now in progress by which insurance on central stations could, where the buildings were of fairly modern construction, be reduced from 20 to 60 per cent. The committee estimated that the changes will save the members from $60,000 to $80,000 in premiums during the coming five years. The losses on the average risk in Illinois were stated to be 55 per cent of the amount paid in premiums, while on the central-station risks the proportion of losses on premiums was ridiculously small. In the discussion which followed, it appeared from the statement by Mr. Niesz, of the Chicago Edison Company, that by some mistake the report of that company was not received by the insurance committee. That company had sustained losses amounting to only 2 per cent of the amount paid in premiums, and part of that loss was through the spontaneous combustion of stored coal in the coal pile. He moved a vote of thanks to the insurance committee for the important results it had secured, which motion was unanimously carried. The committee was continued to investigate the question of public liability and employer's insurance during the coming year.

The convention passed a vote of thanks to the officers for their efficient work during the past year and to the central station men of Peoria for the excellent way in which the convention was being entertained. The convention then went into executive session and elected the following named gentlemen as officers of the association for the ensuing year:

President, Mr. D. Davis, Litchfield; first vice-president, Mr. J. N. C. Shumway, Taylorville; second vice-president, Mr. E. L. Brown, Elmwood; third vice-president, Mr. E. McDonald, Lincoln; fourth vice-president, Mr. E. H. Gray, El Paso; treasurer, W. J. Day, Bement; secretary, Mr. H. E. Chubbuck, Ottawa. Executive committee: Messrs. W. B. McKinley, Champaign; E. G. Schmidt, Springfield; F. J. Baker, Chicago; S. S. Davis, Rock Island; E. B. Hillman, Quincy.

The convention adjourned Thurday noon in order that it might have the afternoon and evening to enjoy the entertainment programme prepared by the local central station men in Peoria. At 2 p. m. a special steamer was in waiting to take the party up to the head of Lake Peoria and return. After this a carriage drive around the city occupied the time until 6 p. m. The party brought up in time for dinner at the Country Club, situated on a beautiful spot on a bluff of the Illinois River, about four miles from the center of the city. The beautiful drive along the river bluff at sundown was enjoyed very much, but not less than the dinner which was in waiting for the entire party at the club. After dinner all were entertained by a theatre party at the Grand Opera House to see Haverly's Minstrels. All arrangements were perfectly made by F. W. Little, manager, and R. S. Wallace, superintendent and chief engineer, of the Peoria Gas & Electric Company, who were the entertainers.

Electric Power in India.

Plans are now being perfected for the generation of electric power on a large scale in the Punjab for transmission to Lahore and Amritsar, the Punjab Power Association of London having been formed for this purpose. The power is to be generated on the Bari Canal and transmitted over a distance of 70 miles to the first mentioned city and 100 miles to that named second. Coal at the points of delivery of the power now costs from $5 to $6 per ton, and it is expected that the low price at which electric power will be supplied will give a great interest to industrial undertakings at Lahore and Amritsar.

The United Provinces Power Association of London has also been formed to develop hydraulic power on the Jumna River and to transmit electric power to Delhi, 140 miles distant, and possibly to Simla, 95 miles distant in the opposite direction. Prof. Carus-Wilson is consulting engineer for the Punjab project, and Messrs. Molesworth and Roechling for the United Provinces Power Association.

Convention of the Western Association of Electrical Inspectors.

The Western Association of Electrical Inspectors, which was organized at Chicago last June, held its convention October 5 and 6 at the underwriters' rooms in the National Life Building, Chicago. Twenty-nine members were present. This organization now has 114 members, 66 of whom are municipal inspectors, 46 underwriters' inspectors and 2 inspectors in the employ of public service corporations. Since the organization meeting last June the secretary has issued eight bulletins and seven committee reports, making in all 51 pages of printed matter. Two of these bulletins called the attention of inspectors to defective material which is being offered upon the market. The other bulletins were on matters pertaining to the association.

A number of suggestions for additions to the National Electrical Code were offered by members, and after discussing these, six were recommended by the association for addition to the code. A number of reports of special committees were heard, most of which were referred back to their special committees for further action. More new standing committees were created as follows: Electric Crane Wiring, Induction Motors, Co-operation with National Electrical Contractors' Associations and Other National Bodies, and Underground Wires. The next meeting will be held at Indianapolis in October, 1906.

The officers elected last June will continue until the next annual meeting at Indianapolis. The secretary is W. S. Boyd, 382 Ohio Street, Chicago.

Indiana Independent Telephone Association.

A meeting of the First District of the Indiana Independent Telephone Association was held in South Bend on October 4 and 5, a large number of delegates being in attendance. Mr. Theodore Thorwood, vice-president of the First District, presided. Many interesting topics relating to the progress of the independent movement in the First District were discussed. Plans were perfected calculated to lead up to a further extension of lines in all localities and into Chicago. Automatic telephone service was explained and discussed, and it was decided to install this system wherever it is possible to do so. Reports were made showing a rapid growth of the independent properties in the district, there being 16,109 telephones now in use.

Among those present at the meeting were George W. Beers, of Fort Wayne, president of the Indiana Association; C. S. Norton, of Indianapolis, secretary-treasurer; and Jesse W. Weik, of Green Castle, member of the executive committee of the State Association. John O. Harney, of Cleveland, assistant secretary of the National Association was present, and gave a talk. A banquet was held at the close of the meeting.

Waterfalls in Egypt.

According to the London *Times*, the electric lighting of the Fayoum is at present under consideration by the Fayoum Local Commision. The scheme provides for the supply of electric power to the factories, established at the capital, Medinet el Fayoum. Overtures have been opened with several companies, and it is being proposed to utilize the waterfalls, situated five or six miles from the town. It may surprise even well-informed persons, including some who have visited Egypt, to learn that there is a difference in levels between the low-Nile at Howara, about 50 miles to the south of Cairo, and the Birket el Qzroun of over 220 feet. This fact was first made public by the researches of Mr. Cope Whitehouse, who has persistently sought to induce American electric companies to take advantage of this magnificent source of electric power, even without any compensation himself. The London Times also states that "irrigation works of an important nature will shortly be commenced in the Fayoum region, a large credit for which has been recently voted." If these irrigation works include the conversion of the Lulu and Raiyan depresions into storage reservoirs, the water power will represent 2,000,000,000 foot tons per day, from a fall of from 15 to 70 feet.

Central Union Telephone Meeting.

Branch managers of 26 exchanges of the Central Union Telephone Company in the northeastern part of Ohio, including the Akron district, held a meeting in Akron September 27. The object of the meeting was to afford opportunity for the managers to discuss methods for improving service, for the maintenance of plants and other topics tending toward improvement. District Superintendent F. G. McConnell presided. All the managers reported that their exchanges are enjoying an increase of business.

The next meeting of the district managers will be held in Akron about the first of the year.

CURRENT NEWS AND NOTES.

PENNSYLVANIA TO ELECTRIFY ATLANTIC CITY BRANCH.—The announcement is made that the Pennsylvania Railroad proposes to electrify one of its Atlantic City lines.

POOL ROOM OPERATION.—Both the Western Union Telegraph Company and the New York & New Jersey Telephone Company have refused the request of Police Commissioner McAdoo to aid the police in detecting pool room operations.

ELECTRIC TRACTION FOR THE ERIE.—President Underwood, of the Erie Railroad, is quoted as saying that a committee is considering the question of electrical equipment for the road's suburban service, also for the section of the line between Susquehanna and Deposit, a distance of 15 miles, where the grades are heavy.

DEATH OF MR. SABIN.—As we go to press we have received telegraphic advices of the death of Mr. John I. Sabin, one of the leaders of electrical development on the Pacific slope, and for a great many years foremost as a successful telephone manager. He was not in good health, and was contemplating a six months' European tour, free from all business.

BAD WIRE CONDITIONS.—City Electrician Corson, of Haverhill, Mass., has been investigating the condition of the police signal and fire alarm wires that were placed underground in the conduits four years ago, and he has found that the wires are in a bad condition. He reported the conditions at the last meeting of the committee on fire department and was authorized to secure estimates of the cost of reconstructing the systems. Mr. Corson has been unable to find any plans of the municipal wires that were placed under ground and he is unable to tell the exact amount of wire that will be needed to reconstruct the two systems. It is estimated that it will cost about $3,000 to reconstruct the entire system with the use of lead-covered cables.

ELECTRICITY FOR CHINA.—The following item is from the Seattle (Wash.) *Times*: "Albert C. Lee, of Providence, R. I., an electrical engineer, and Y. C. Lee, of New York, a civil engineer, cousins and both natives of China, have been summoned to Canton by the viceroy ruling that province to make the preliminary estimates for the installation of a big municipal power and lighting plant, with the probability that a system of electric railways under municipal control will follow. They sailed on the *Dakota*. The expenditure of millions of dollars to give the city of Canton a modern lighting and power plant will follow the reports of these two Chinese authorities, both of whom have been educated in this country. In fact, Albert C. Lee has been in America for thirty years, is married to an American woman, and declared to-day that he had almost forgotten his native tongue. Y. C. Lee, in America for seven years, speaks English with a fluency creditable to a native. If the city of Canton builds the big electrical plant now planned it is probable that American manufacturers will supply all materials. Albert C. Lee has worked in his profession with American goods and places the utmost confidence in them. Both men believe American electrical machinery better adapted than any other to the Chinese requirements."

THE OHIO INTERURBAN RAILWAY ASSOCIATION.—This association will hold a meeting at the Chittenden Hotel, Columbus, October 26. No definite programme has been arranged. It is the intention to discuss general plans for the future.

POWER IN PERU.—The waters of Lake Titicaca, the largest body of water in Peru, and the highest navigable lake in the world, are to be utilized for electric power development in connection with various enterprises in its vicinity, and for long distance transmission.

PITTSBURG TELEPHONE CONVENTION.—The Pennsylvania State Independent Association will hold its annual convention on November 9 and 10, at Pittsburg. A large attendance is expected. Mr. H. E. Bradley, 135 South Second Street, Philadelphia, is secretary.

NEW YORK ELECTRICAL SOCIETY.—The opening meeting of the season of the New York Electrical Society will be held at the Edison station, Twenty-seventh Street, near Sixth Avenue, Monday evening, October 23. Mr. Peter Cooper Hewitt will lecture on "Electrical Reactions of Gases."

ALBANY WIRES.—It is proposed to install an extensive conduit system at Albany, N. Y., and a sub-committee has reported on a plan for thus disposing of all the telephone and telegraph wires, taking one district at a time. Some work has already been done by the Western Union and Postal Telegraph Companies, the Hudson River Telephone Company and the Home Telephone Company.

ELECTRIFIED ITALIAN ACTIVITIES.—U. S. Consul Dunning, of Milan, reports activity in Italian industries. He says that new textile, chemical, cement, chocolate, silk, and other factories are going up all over the northern part of the peninsula, or are being enlarged. The present prosperity is doubtless due in large measure to the utilization of the waters of the Alps and Apennines for generating electricity for light and power.

BLACK SANDS.—Dr. David T. Day, chief of the division of mining and mineral resources in the U. S. Geological Survey, is now conducting an investigation of the black sands of placer mines of which there are now 8,000 in the United States. Dr. Day has received some 828 samples up to date of report from all over the country, and a laboratory is at work at the Portland Exposition. Magnetic separators are a prominent part of the apparatus.

IMPORTANT WIRELESS TRANSACTION.—The European and colonial rights of the American De Forest Wireless Telegraph Company have recently been sold to an English syndicate by Frank Z. Maguire, of New York and London. Mr. Maguire is well known in electrical circles and has been developing American enterprises abroad for a number of years past. Lord Armstrong, of the great shipbuilding concern of Armstrong-Whitworth, is the chairman of the new company, and it is understood that a number of other prominent financial men are connected with the enterprise. The patents of Nevil Maskelyne are included in the purchase. The capitalization is £120,000.

OHIO INDEPENDENT TELEPHONE ASSOCIATION.—A meeting of representatives from companies in the seventh district of the Ohio Independent Telephone Association met in semi-annual session in Lima, Ohio, October 5. Mr. D. J. Cable, of Lima, in the absence of vice-president George H. Metheaney, called the meeting to order. Independent telephone affairs were discussed, and plans broached for big improvements in individual exchanges. The district has 73 exchanges, as against eight of the Bell; and 86 toll stations, as against 76 of the Bell, while individual subscribers now exceed 22,500 offices and residences. Every company reported an increase in business for the past six months. Among those present from outside the district were F. L. Beam, of Mt. Vernon, president of the Ohio State Association, and A. D. Kramer, C. Y. McVey and M. B. Overly, capitalists of Cleveland.

FARES TOO LOW.—United States Consul Daniels, with regard to the municipal electric railway at Sheffield, writes to the Department of Commerce and Labor: "The city of Sheffield, in the management of its electric tramway system, finds itself confronted with a condition that some of the more far-seeing members of the city council (notably Sir Joseph Jonas, the lord mayor) have insisted, has existed for some time, and that condition is, despite the fact that the system has been operated at an apparent profit, while furnishing cheaper transportation than any system in the United Kingdom, due to a failure to properly charge off a reasonable amount yearly for depreciation of plant. This failure brings them face to face with the necessity of adjusting and raising the fares or operating the system at a loss, possibly, or, at any rate, no profit." This absence of a proper allowance for depreciation is unfortunately a common failing in such enterprises.

PRINTING TELEGRAPH.—The printing telegraph system of Mr. John C. Barclay, assistant general manager and electrical engineer of the Western Union Telegraph Company, has been described in these columns. Patents on details, etc., are being issued almost every week. On October 3 a further patent was granted to Mr. Barclay on a method of avoiding sparking at the contact points of the selecting relays of his receiving apparatus. Mr. Barclay found that when the circuits controlled by the selecting relays were broken by the return of the armatures to their normal position objectionable sparking resulted at the contact points. In the patent just issued it is shown that he overcomes this objection by breaking the circuit through the contact points before the points themselves are separated. In many telegraph instruments it is customary to minimize the effects of breaking a circuit at contact points, but in this instance Mr. Barclay removes the cause of the sparking before the effects can be produced.

THE BERLIN ELECTRICAL STRIKE.—The latest information cabled to this country regarding the strike of electrical workers in Berlin is to the effect that the companies expected a complete victory. The men's main hope to compel concessions by depriving the city of electric light has been shattered by an influx of non-union electricians from the provinces, attracted by the liberal terms offered by the companies. These men, with many engineer students from the technical schools, are working under police protection. They are sumptuously fed and housed and their work has prevented any trouble to the users of electric light. A committee of the strikers appealed to Burgomaster Kirschner to mediate, but notwithstanding this 25 meetings on the night of October 3 resolved to continue the strike. These probably took heart from sympathetic strikes as Breslau and Hanover. The strikers there have been successful in interrupting the tramway service. The larger part of public sympathy is said to be with the employers, who have the reputation of treating their men well.

CABLING PEACE.—In these electric times the old slow methods of ratifying a peace are obsolete. It is announced from Washington that the treaty of peace between Russia and Japan will become effective upon its approval, without waiting the formal exchange of ratifications at Washington. This course has been decided upon that the speediest possible termination of the war may be had. The treaty, it is understood, has passed through the necessary preliminary stages of approval in each country and is now before the respective Emperors of Japan and Russia for the royal signatures. As soon as it has been signed this fact will be communicated by cable to the State Department at Washington, and the Washington Government will apprise each Emperor of the act of the other. With this accomplished the war will be at an end. The formal exchange of ratifications will be carried out in Washington as soon thereafter as the signed treaties reach here. This formal exchange will be accomplished by the drawing up and signing of a protocol or memorandum of exchange by special plenipotentiaries commissioned for that purpose. Besides signing the protocol the copy of the treaty which the Emperor of Russia has signed will be delivered to the Japanese plenipotentiary for transmission to Japan, and the copy signed by the Emperor of Japan likewise will be delivered for transfer to St. Petersburg. This act, according to present intentions, will be devoid of all formality. As yet the special plenipotentiaries have not been commissioned and no arrangements have been made for the exchange. Precedent is found for the telegraphic exchange of ratifications in the manner in which the last treaty between the United States and China was made operative.

WIRELESS BETWEEN NEW YORK AND CLEVELAND.—It is stated that wireless telegrams were successfully exchanged between New York and Cleveland, on October 6. The distance between the two cities, in a direct line, is about 550 miles.

POLICE TELEPHONES.—With the aid of the new police telephone signal boxes, operated as a part of the New York telephone system, the local police were able to catch a negro murderer in about forty-five minutes after the deed had been committed.

NEW YORK CITY LIGHTING PLANT. The Bridge Department has made arrangements with the electric lighting companies to purchase their wires, etc., on the Williamsburg Bridge, so that they will not have to be removed when the city starts to operate its own lighting plant under the bridge. This plant, which will have a capacity of 400 hp, will be ready for use soon. It will cost the city $100,000 and will utilize street refuse for fuel in the generation of steam.

GOVERNMENT WIRELESS SERVICE.—A dispatch from Newport, R. I., states that on October 6 the naval torpedo station at that point was in wireless communication with Cape Henry, Washington, Philadelphia, Salem, Boston, New York and Long Island. The tests are to continue for several days. By using a German system eighteen words a minute were received clearly and accurately from Cape Henry, a distance of 350 miles; Washington, 325 miles; Philadelphia, 250 miles, and Portsmouth, 150 miles.

ALTERNATING-CURRENT TESTING COURSE.—The evening course in alternating-current testing to be given at the Polytechnic Institute of Brooklyn will begin Thursday, October 12, at 7.30 p.m. and will extend over a period of twenty successive Thursday evenings. This course will consist of twenty elaborate tests upon rotary converters, transformers, induction motors and other alternating apparatus. Reports in engineering form will be expected of the students. The course will be under the direction of Sydney W. Ashe, who had charge of the direct-current course last year.

NEW YORK Y. M. C. A. COURSE IN ELECTRICITY.—The Young Men's Christian Association of New York City in its night school, held in the West Twenty-third Street building, gives a two-year course in electricity, the instructor being Mr. James Mason Knox. The first year course is intended for students who have had little or no previous knowledge of the subject, or whose knowledge is fragmentary or deficient in elementary principles. The second year course is designed for students who have had some experience in electrical lines. This latter course consists of a review of the elementary principles of electricity and a consideration of direct-current and alternating-current apparatus and their operation.

BIG INTERURBAN CONSOLIDATION.—A Washington dispatch states that nearly all the interurban electric railroads of Ohio and Indiana are being merged by Philadelphia capitalists. Two holding companies are to be formed, one in Ohio and one in Indiana. Hugh J. McGowan, president of the Indianapolis Terminal Traction Company, will be at the head of the Indiana holding company, and J. C. Schoepff, president of the Cincinnati Traction Company, at the head of the holding company for Ohio. About $50,000,000 is involved. The syndicate is known as the Elkins-Widener-Morgan-McGowan combination. Several central west men are associated with the Eastern financiers, among them Senator Foraker. There are about 1,200 miles of line in each State.

TELEPHONY IN MANILA.—The Philippine Islands Telephone Company, composed of leading capitalists representing large telephone and banking interests of San Francisco, is preparing to begin business in the city of Manila. A 50-year franchise has been secured. Louis Glass, general manager of the Pacific States Telephone & Telegraph Company, of San Francisco, is president, and E. C. Gee, is manager of the new company. The underground conduits are now being installed by Mr. Gee. A fire-proof building will be erected at once to accommodate the telephone exchange and offices. About 3,000 subscribers are expected at the start. The Western Electric Company has contracted to supply the common-battery multiple-switchboard plant, installed ready for use by April 16, 1906. This equipment will be made in New York and shipped via the Suez Canal. About $180,000 has been paid up on the capital stock of the company by John I. Sabin, Louis Glass, Homer S. King, W. H. Crocker, Charles R. Bishop, S. G. Murphy and their associates. Manila will be given a telephone service equal to the best in this country.

Electrical Engineers of the Times.—XXXI.

MR. CHARLES H. HINES.

Charles H. Hines was born in Buffalo, N. Y., March 6, 1865. His primary and high-school education was received at Plainfield, N. J. While following the medical course in the New York Medical College, he became interested in electricity and in 1884 he entered as a student the works of the Daft Electric Company at Greenville, N. J., where, under the personal supervision of Mr. Leo Daft, he assisted in the first commercial railway work in this country, and in equipping the cars Volta, Ampere and Ben Franklin, the latter being used in the Daft pioneer experiments on the New York elevated. From 1886 to 1891 he was in the employ of Mr. Augustus Noll and the Edison Electric Illuminating Company of New York, passing from a workman to general foreman. In 1891 he went to Salvador, Central America, where he designed and erected steam and hydraulic alternating-current plants in two cities, these being among the first electric plants installed in those countries.

MR. C. H. HINES.

In 1893 he installed the city plant at Tampico, Mexico, and also in the same year that at Newton, N. J. In 1896 he became superintendent of construction for the Andrews-Ryan Company of Boston, and installed two central exchanges, at Hampton, Va., and Haverhill, Mass.

In 1898 and 1899 Mr. Hines was engaged in cable work at Santiago and Manila, and in 1901 while a constructing engineer for the General Electric Company in the foreign department, erected large plants at Charleston, S. C., and Banes, Cuba. In August, 1901, he was appointed superintendent of the electrical department of the Lorain Steel Company, remaining with that company until February, 1893, when he was appointed electrical engineer of the Canadian Pacific Railroad. While occupying this latter position he designed large plants at Montreal and Fort William, aggregating 10,000 hp, and had charge of the electrical work of 8,000 miles of railroad and two steamship lines. This position he resigned to accept employment by the Erie Railroad Company as consulting engineer and to prepare a report on equipping the Erie shops electrically. Upon the expiration of this duty Mr. Hines went to the United States of Colombia where he reconstructed the Medellin electrical generating plant. While here he became interested in gold mining and upon his return to this country was sent back as superintendent of two large gold mining properties.

Mr. Hines is an inventor in several departments of electrical engineering and has been granted patents among others on a brush holder, magazine arc lamp, reduction furnace, controller, brake, system of car ventilation and method of winding coils. He has contributed a number of articles to the technical press, dealing principally with electric power distribution in shops.

Electric Power on the Blackstone River, Massachusetts.

BLACKSTONE RIVER is a succession of water powers. Rising in Worcester County, Massachusetts, this stream flows about 50 miles to tidewater at Providence, R. I., with a total fall of some 600 ft. Its drainage area is not far from 500 square miles and its normal discharge seems to vary between two and three thousand cubic feet per second at a point about ten miles above its mouth. At intervals of several miles along the greater part of the length of the Blackstone, dams have been erected to develop its power for a large number of mills, most of which are devoted to some branch of the textile industries. Such a development has been made in the river close to the point where it crosses the line between the States of Massachusetts and Rhode Island, by the Blackstone Manufacturing Company, in the town of that name. This water power development differs from others along the river, however, in that electric energy is the means used for its distribution in a large plant devoted to the manufacture of cotton cloth. In this case the power house and the great cotton mill are only 600 ft. apart, and the electric distribution was adopted because of its superiority over mechanical methods.

For the purpose of this water power development a masonry dam was laid across the Blackstone River a fraction of a mile above the site of the power house (see Fig. 1) and a large storage pond was thus created. A canal brings water from this pond to the point on the river bank where the power is to be developed, and maintains there a head of 32 ft. above the river level. Between the end of this canal and the river is the power house with concrete foundation that contains arched openings for the tail water, as shown in Fig. 2. On leaving the canal water passes down through four vertical turbine wheels that set near the bottom of the pit. Each of these four wheels is 45 in. in diameter, is rated at 375 hp under the head of 32 ft., and its vertical shaft connects through bevel gears with a common horizontal shaft on the main floor of the station above. These vertical turbines and the improved Lombard governors by which their speed is regulated were made by the Holyoke Machine Company, Worcester, Mass. For the horizontal shaft to which the four turbines are geared the speed of revolution is 200 per minute, and this shaft carries the revolving magnets of an 840-kw, three-phase, 60-cycle, 440-volt generator, at one end. The entire discharge of the river is said to yield from 700 to 1,600 hp for the operation of this generator.

Besides the water-driven alternator just named the same power station contains a 750-kw steam-driven generator which is used to supplement the output from water power. A cross-compound horizontal engine, with cylinders of 24 and 48 in. diameter and 48-in. stroke, carries the revolving magnets of this 750-kw generator between the two main bearings, and operates at 90 r.p.m. This engine was made by Filer & Stowell, Milwaukee, Wis.

FIG. 1.—DAM OF BLACKSTONE MANUFACTURING COMPANY.

Exciting current for the two alternators is supplied by two belt-driven, four-pole dynamos each rated at 22½ kw, 125 volts and 600 r.p.m. Steam for the engine just named is generated at 125 pounds gauge pressure by three Sterling boilers rated respectively at 200, 250 and 400 hp, and the engine usually operates with a vacuum of 25 in. The gases of combustion pass from these boilers to a Green economizer before they reach the chimney, and in the economizer their temperature is lowered to about 235° F., at light loads and 285° at heavy loads. In spite of these low temperatures in the gases no mechanical draft is employed, and the brick chimney, 178 ft. high and of 6 ft. inside diameter, gives all the draft that is required. Feed water from the river has its temperature raised to about 240° while passing through the economizers before entering the boilers.

The switchboard in this generating station is equipped with a watt-hour meter in the circuit of each main generator, besides the usual indicating instruments, and the electric outputs from steam and water power are recorded separately. All of the generating equipments above named are contained in a one-story brick building with a basement underneath the engine room. Between the engine and boiler room there is a heavy brick wall. The floor of the engine room is of wood, and the roof is supported on steel trusses. Pocahontas lump and slack coal is fed to the boiler furnaces by hand and a large quantity of this coal is stored below the high bank just outside of the station. This coal is now carted from the railway, but later a spur track will bring it to the storage space. From the power station to the large cotton mill where electric

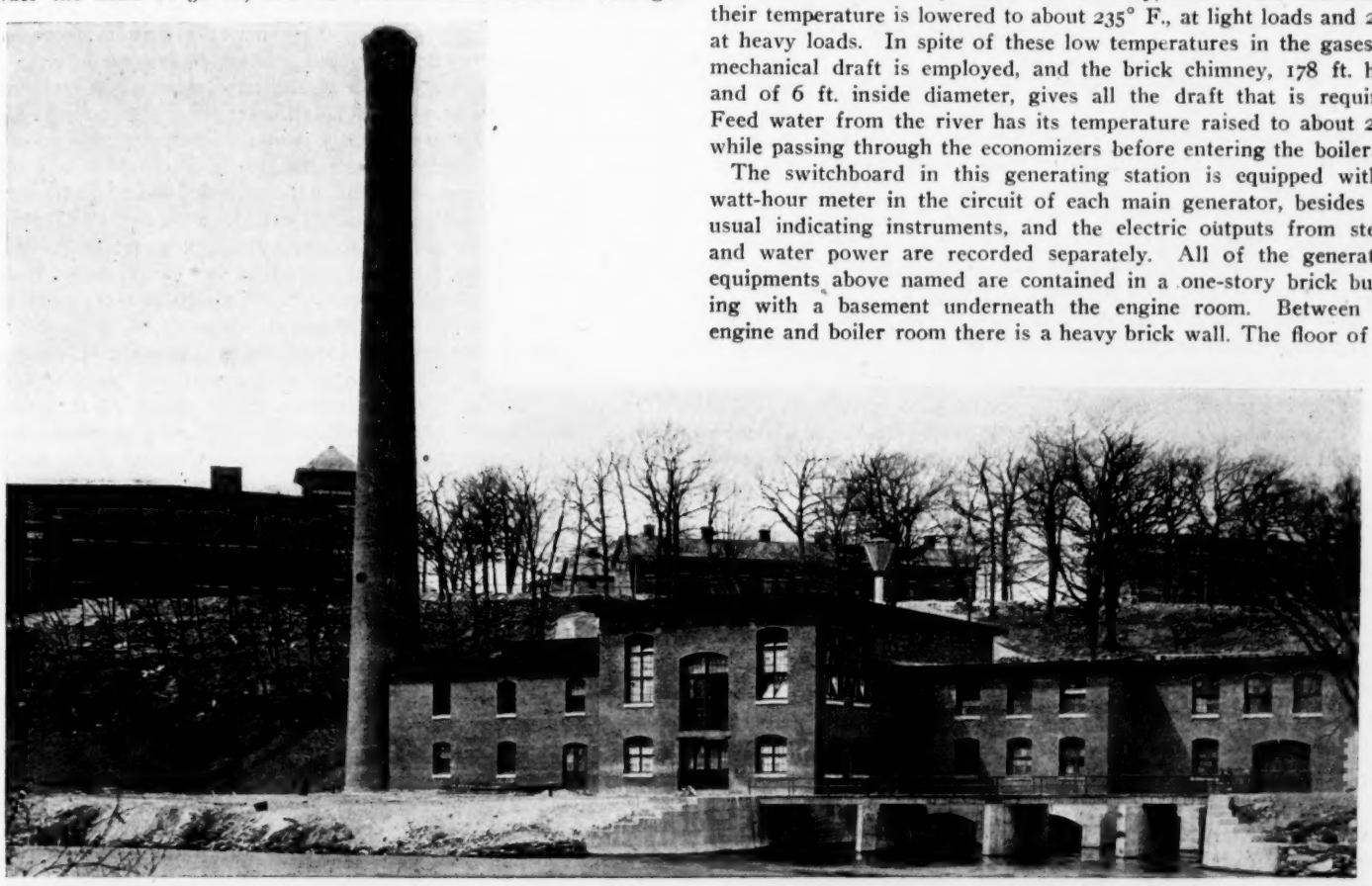


FIG. 2.—VIEW OF COMBINED STEAM AND WATER POWER STATION.

energy is used in motors, a distance of about 600 ft., there are two three-phase, 400-volt circuits made up of bare copper cables supported on wooden poles. Each of these cables has an area in cross section of 600,000 circular mils.

The mill in question is a brick building with three stories and a basement and is devoted to the manufacture of cotton cloth and sheetings. On the several floors the processes by which raw cotton is converted into finished goods are operated entirely with electric power. For the transformation of the electric to mechanical power, 440-volt, three-phase induction motors are employed. These motors are suspended from the ceilings and are connected by belts with the long lines of shafting that drive the looms and other machinery.

On the first floor of the mill, which is devoted to weaving, the looms are driven from motors and shafting on the basement ceiling, so that the space above the looms is clear of belts. Power for the entire mill is supplied by sixteen induction motors that range from 15 to 150 hp in individual capacity, and have a combined rating of 1,365 hp. The list of motors includes four of 150, eight of 75, three of 50 and one of 15 hp.

Spinning and weaving operations offer a more constant load than that in many other lines of manufacture, and as the entire output of the power plant is metered in this case it is possible to determine the ratio between the average rate of energy consumption and the total motor capacity. This ratio may be found either for the motor rating, which represents the capacity to deliver mechanical power, or for the capacity of the motors to absorb electric power, which involves their efficiency. Of these two ratios the one involving the efficiency of the motors in the way just stated is the more useful for some cases, but the ratio between motor rating and the average power consumed is sufficient for present purposes.

As all the motors in the cotton mill have a combined rating of 1,365 hp, it is evident that if operated at full and constant load they would do 1,365 hp-hours of work per hour. To do this work the motors would necessarily absorb more than the equivalent amount of electric energy, because of their internal losses, but the energy actually received by the motors would cover all losses as well as the mechanical work delivered.

With these principles in mind it is instructive to compare the electric output of the power station with the motor rating during certain periods of operation. For this purpose the output of the power station is taken during each of four recent consecutive weeks. During the earliest of these weeks the mill operated 58 hours and the total output of the power station was 55,330 kw-hours, so that the average load was 953.9 kw, or 1,278.6 hp. As the motors are rated at 1,365 hp, it follows that the average rate of consumption of energy by the motors during this week was equal to 93 per cent of their total rating. This includes the small loss in the distribution circuits.

During the second week the mill again operated 58 hours and the output at the power station was 55,600 kw-hours, amounting to an average of 958.6 kw, or 1,284.9 hp of load. The motors during the working hours of this week, therefore, absorbed energy at an average rate equal to 94 per cent of their rating. In the third week the mill operated 47.5 hours and the entire output at the power house was 42,320 kw-hours, corresponding to an average load of 890.9 kw, or 1,194.2 hp. This average load was 87 per cent of the motor capacity. Operating time for the mill in the fourth week was again 58 hours, and the electric generators delivered 49,350 kw-hours through the meters, representing an agerave load of 850.8 kw, or 1,140.4 hp. In this case the average load was down to 83 per cent of the motor rating.

It may be suspected that the lower percentages of average loads to motor capacity in the two weeks last named was due to the non use of a part of the mill machinery, but this cannot be definitely stated. Where electric energy is to be purchased by meter for the operation of a large equipment of motors, data of the sort just considered aids materially to determine the amount that will probably be consumed, in any given class of work.

By means of the watt-hour meters in the circuit of each generator at the power station, independent records are kept of the energy outputs from steam and water power. As the company controls the entire discharge of the river, the rule is to utilize all the available water, and to use only as much steam as is necessary to meet the additional demand for power. During the earliest of the four weeks above named, the generator driven by water power delivered 69 per cent of the entire electric output of the station. For the following week water power did 65 per cent of the entire work. Water was falling in the river at this time and in the third week it carried only 53 per cent of the average load. In the fourth week the percentage of the electric output developed by water power was 51. These weeks are taken in one of the dryest times of the year, and it seems probable that in some months much larger parts of the entire load might be carried by water power.

During the week above named, when water developed 69 per cent of the total electric output, the work done by the water power was 38,540 kw-hours, which corresponds to an average load of 664 kw, or 890 hp. This power is developed by about 246 cu. ft. of water per second falling 32 ft., and if the combined efficiency of the penstocks, turbines, gearing and shafting, and generators may be taken as 65 per cent, then 379 cu. ft. of water per second would be necessary to develop electric energy at the rate of 890 hp.

All of the electric equipment above named was manufactured by the Westinghouse Company. The description of this interesting distribution of electric water power has been obtained through the courtesy of Mr. George E. Spofford, superintendent of the Blackstone Manufacturing Company, of Blackstone, Mass., and Providence, R. I.

Central Station Management.

Under the head of "Management" the "Question Box" of the National Electric Light Association gives in 21 printed pages answers to 19 queries relating rather to the technical than the business side of central station management.

Seven replies are given to the question whether a day service is justifiable in a small town, what kind of power business can be worked up in such a place, and what system of charging should be applied. One answer is "No"; another that a power service would not pay in a town under 5,000 population, and a third that it would not pay in a residential town. One answer gives the caution that any company seeking power business should be very careful not to take on power that will lap over into the lighting period too much in the winter. Another states that the class of power business in such plates is apt to be intermittent service for very small users, and even at a relatively high rate the total income would not be sufficient to warrant the expense of carrying the business. Where motors are very small or the use is intermittent a 10-cent rate should be low enough, and a 5-cent rate should be the very lowest limit. Two of the answers state that the rate will depend entirely upon the hours the power is used and upon the operating expenses of the plant, and one suggestion is for a sliding schedule of rates the same as for lighting, but less by the cost of lamp renewals.

The matter of thawing out frozen water pipes was the subject of five replies, and in each instance it was stated that this work was found profitable. In one case a water barrel resistance was used with a 15-kw, 2,000-100-volt transformer, the secondary main being a No. 4 wire. By this arrangement pipes varying from ¾ to 5 in. in diameter were thawed out. The standard charge was $7.50 for each pipe, but if two houses were on the same service a reduction was made. The average return after deducting the entire labor charge was something like 50 cents per kw-hour. While the above-mentioned arrangement worked well, another is recommended, consisting of a 10-kw transformer with a secondary wound for 50-100-200 volts, together with a reactance coil for 250 amp. In another case a transformer was used, giving 55 volts in the secondary, with reactance coils for control; with this pressure any ordinary ¾-in. iron service pipe about 125 ft. long will be thawed out with 135 amp. in from four to eight minutes. A direct-current station used an automobile charging rheostat for short lengths of pipe and a water rheostat for larger lengths, the voltage being 110 and 220. One of the contributors recommends that there should always be an ammeter in circuit and that judgment must be applied in determining how much current may be safely used at any particular place. The New York Edison Company reported that the electric current is the quickest and cheapest one for thawing out pipes and the results are very satisfactory. When the current was taken from the New York distributing system a water rheostat was used, and when storage cells were used they were variously connected so that different voltages could be applied to the frozen pipe.

The following query received six replies: "Will a small central

station with no day circuit, and operating at 1,100-52 volts at 125 cycles, be warranted in changing over to 2,200-230-115 volts, 60 cycles, the transformers being old, but the wattmeters comparatively new and of the commutator type?" Two of the replies are in the affirmative, two in the negative and two are qualified. One of the former is in the affirmative, provided the plant is a growing one, and another that the change would be advisable, the old wattmeters being suitable for the higher frequency. Another reply advises scrapping the old transformers or placing the primaries of two transformers in multiple and the secondaries in series, thus getting 104 volts and using two-wire secondaries instead of three-wire, as proposed. Another reply is that the change could be made by simply purchasing new transformers. Two of the replies state that there is no advantage to be gained by changing over from 125 to 60 cycles. One of these adds that transformers are more efficient at 125 cycles than at 60 cycles, and another implies that the reverse is true. It is also stated that a 50-volt commutator meter can be changed to 100 volts at a cost of $6 each. An inquiry as to what charge should be made for inspecting the wiring in a house which was wired when built, but to which current is not supplied until several years later, brought out four replies, none of which favor any charge. As to inspection, in one case this is done by the central station for the underwriters. Another advises the maintenance of an inspection system unless this is provided for by the municipality or underwriters or both; and a third that the company should examine all wiring independent of the underwriters.

A question as to whether a central station in a town of 10,000 people should do the house wiring and deal in fixtures brought forth nine replies, of which only two were in the negative, two were non-committal and the other five strongly in the affirmative. Of seven replies to an inquiry as to the advisability of charging a 5 per cent penalty for non-payment of bills in ten days from their date, five are unqualifiedly in the negative; one company reports that it charges at least a 10 per cent penalty for non-payment of bills after ten days from date, and another that a cash discount of 10 per cent on all bills paid before the 15th of the month is the most satisfactory method of bringing about prompt collections. Most of those replying in the negative state that it is illegal in their States to charge penalties for non-payment of bills.

An example of the little attention paid by central stations to systematic methods for obtaining new business is given in the fact that not a single reply was received to a query asking what percentage of income is spent for soliciting and advertising. The charge for cutting of wires and interruption of service by the moving of houses was the subject of seven replies. One central station always moves its wires free of charge when in the way of moving buildings or when trees are taken down; another always renders bills for this work, but in no instance has it been found possible to collect them, notwithstanding that an ordinance had been passed in favor of the central station. In another case all time over two hours at each crossing is charged for. In the case of the other station's reporting, a charge is made to cover the expense and no difficulty has been found in collecting the bill.

An interesting subject was brought up in an inquiry asking if an electric light company with a 20-year franchise granting the use of one side of alleys for the erection of pole lines can prevent any other company, either lighting, telephone or telegraph, from using the same side of the alley by placing its poles between its wires. One reply is that if the second company receives a franchise to erect poles and string wires, it would seem that the first company did not have an exclusive franchise, and it is, therefore, apparently unable to prevent the second company from erecting poles between its wires and stringing wires above or below. The first company, however, should be able to claim damages for any injury done to its poles, wires or service by the second company. Another answer is that if the company can prove that the new company has entered its property, limited its capacity or in any way injured its service or its employes, the courts would doubtless give redress. The advisability of charging for the fittings of the "Meridian" lamp was the subject of five replies. In one case the fittings are given free of charge; in two cases the first fittings supplied are free and renewals charged for, and the advice of two others who submit replies is to charge for the fittings.

The query "Who pays for the street connection, the electric light company or the consumer?" received 14 replies, are unanimous in the opinion that the lighting company should stand the expense. Free commercial arcs and rates for the same was the subject of 11 replies, every one stating that the practice of the writer's company was to furnish arc lamps for commercial lighting free, the lamps remaining the property of the company. In two cases the wiring is charged for, but in all cases there is no charge for keeping the lamps in repair. In only one case is a flat rate charged, in all others the rate being on a meter basis. An inquirer who wishes to know under what conditions a small central station at present equipped with 133-cycle apparatus would be justified in changing over to 60-cycle apparatus is informed in three answers that the change would only be justified in case a power load can be worked up. One answer qualifies this with the statement that an inductive load of arc lamps for small motors might give rise to a serious reactive drop with 133 cycles, while on the other hand Nernst lamps appear to have a longer life on 133 cycles than on 60 cycles. A single answer to a query on the subject of recruiting central station employes states that the best method is the apprenticeship system. By this system the young men secured can be made to serve in the various departments, say six months in each, the salary being increased as they become more efficient. The apprentices should at least have entered a high school prior to employment.

A question of policy is discussed in reply to a query asking if it is advisable to make a rebate to hold a consumer in case of a disputed bill, it being known that the meter and meter readings are correct. The majority of the 9 replies strongly advise to stand by the record. Several answering are, however, of the opinion that rather than lose a profitable customer it is advisable to propitiate him by according a rebate. As to whether it is good practice to insist on deposits from all consumers, irrespective of their responsibility, 9 opinions are expressed, only one of which is unqualifiedly in favor of demanding deposits from all consumers; a second favors the practice with a few exceptions owing to the profit from the interest on the deposits, but all others condemn the practice of exacting deposits from responsible customers. Another question of policy came up in connection with an inquiry as to the practice of central stations with respect to turning current on an installation which has not been properly made, but which has been passed by the city inspectors. Two of the three answers favor making a protest in writing; the third says that the test should be as to whether the installation would endanger the company's lines or apparatus.

District Electrical Supply.

In a paper read last week before the Illinois State Electric Association, Mr. W. R. Pinckard discussed the subject of the transmission, from existing central stations, of electricity for power and lighting to be used in small towns and rural communities, from the standpoint of the smaller central stations in cities of from three to ten thousand inhabitants, assuming that their systems are generally single-phase, with a frequency of 7,200 or 16,000 alternations, and not treating the question of transmitting large amounts of current by the two or three-phase system at very high voltages for power purposes.

Almost the entire territory of the State of Illinois presents attractive opportunities for the expansion in this direction of the type of plants referred to. It is probably true that where water power is available, current for power and lighting can be distributed over a wide territory at a cost which could not be met by steam power under ordinary conditions. However, there are central stations favorably located for fuel at a low price, with ample water for steam and condensing purposes, which might find it profitable to transmit current within a radius of about twenty miles, for the purpose of supplying outlying communities of from 200 to 2,000 inhabitants, and, possibly, also furnish large farms along the transmission line with current at profitable rates for lighting and power. This idea is now being tried in several localities in this state, two of which are quite ambitious, but they are neither of them yet in operation, though they probably soon will be. In one case the objective point is a town of about 1,500 inhabitants, sixteen miles from the central station. This place has a steam plant in which everything inside the station will be abandoned, with the exception of the switchboard. Thereafter the series alternating-current street arcs and the incandescent lighting for

stores and residences and such motor service as may be secured, will be supplied by the central station sixteen miles away. It is commonly accepted as the rule that the voltage on such a line should be at the rate of about 1,000 volts per mile of line or circuit; therefore, in this case, the power is to be transmitted at 16,500 volts.

With such a business as a nucleus it gives the central station access to some other business adjacent to its transmission line. There are in many localities, progressive farmers who desire the convenience and safety of electric light in their homes and barns and such service could be supplied to them without entailing too great a cost for apparatus, since a transformer is all that would be required. Mr. Pinckard cited one instance in the state where there is a large dairy farm provided with an electric light plant of its own, driven by a gasoline engine and furnishing current for about 200 incandescent lamps. The engine is used during the daytime for grinding feed, pumping water and other power required about such an establishment. The owner would be glad to take current from an interurban line, should there be one near by, as the use of the gasoline engine is dangerous and requires the services of an expert to keep it in order. In addition to the lighting it might be found profitable to furnish such farmers with the power required in threshing, shelling corn, sawing wood, etc.

Several manufacturers of transformers now furnish, as a standard line, oil insulated transformers in sizes from 1 to 50 kw for 3,300, 6,600, 11,000 and 16,500 volts primary, arranged for either 1,100 or 2,200 and 110 or 220 and 220 or 440 volts on the secondary side; therefore, being standard, they can be secured within a reasonable time and at a reasonable price. However, owing to the necessity of providing insulation required for the high voltage, the cost of such transformers is considerably higher than those wound for only 1,100 or 2,200 volts primary. Some of these transformers are provided with multiple ratio taps; so that the secondary e.m.f. can be raised 5 or 10 per cent, thus compensating for that amount of drop in the line. The step-up and step-down transformers at the ends of the line should be located in substantial, fireproof buildings, wherein should also be installed the necessary lightning arresters and such switchboard apparatus as may be required. Intermediate transformers along the line may be suspended from poles in the usual way, but on lines above 6,600 volts the fuse boxes are not made for outdoor service and would have to be mounted under cover.

The line should be of bare copper, and great care should be exercised in the selection of poles, cross arms and insulators. The poles should, of course, be so placed and of such a height that they would clear all trees and, where necessary, the limbs of the trees should be cut away so that they would not come in contact with the lines.

Another important point to consider is the protection of such a line from injury by lightning. For this purpose several manufacturers furnish lightning arresters for the protection of high-voltage transformers and these should be installed in all cases. One arrester would be required for each line of the circuit and at each end of the circuit on the high tension side. If there are transformers located along the line they, of course, should also be protected. It should be borne in mind that the most expensive lightning arrester affords no protection without a good ground connection.

There are other factors to be considered under certain circumstances. For instance, "when more than one transmission line is strung on the same poles the alternating-current in each line induces e.m.f's in the other lines and affects the line drop. This interference of one line upon another is, however, obviated by crossing or transposing the lines at frequent intervals." Some engineers, however, do not recommend this practice. Another consideration is the power factor of the load. In the case of incandescent lighting only, this amounts to practically unity and need not be considered, but in the operation of alternating-current arc lamps and motors, creating a low power factor on the line, it would have to be taken into consideration. Core-loss, efficiency and regulation of transformers should also receive consideration.

To enter this line of work will probably necessitate an increase in present central station equipment and a considerable investment in the necessary transformers and pole line, and to what extent it is profitable to do this depends upon the revenue to be secured. It is a subject well worthy of study by any who may have reached the limit of business in their own community and who find it necessary to go outside after more business or else be content with what they have.

The Design of Multiple-Coil Windings.

By CHARLES R. UNDERHILL.

AMONG the several methods of winding electromagnets so that the sparking due to self-induction shall be minimized, the best two are what are known as the differential winding and the multiple-coil winding. This does not refer to external methods of compensation.

While the differential winding (of which there are two classes) is very effectual in suppressing the "sparking," the winding is not very economical for continuous duty, as only one-half of the winding is available for magnetizing the core. However, the differential winding is less expensive in first cost than the multiple-coil winding, for a given voltage, as much coarser wire and less turns are used in the former than in the latter.

The extreme commercial condition for the multiple-coil winding is illustrated in Fig. 1, where the respective ends of each layer are

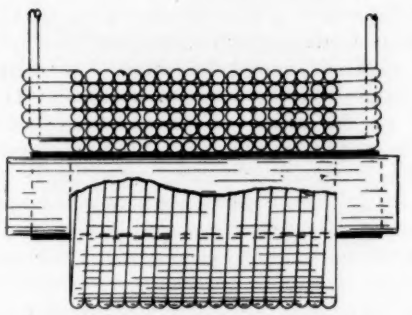


FIG. 1.—WINDINGS WITH LAYERS CONNECTED IN MULTIPLE.

all connected together. Since in this type of winding the full voltage is across each of the multiple wires or separate coils, this arrangement is not practicable for comparatively high voltages on coils of moderate size, as the wire in each layer would have to resist the full line voltage without overheating. This applies most fully to the first or inner coil, which having the least resistance must pass the most current.

The principle of the multiple-coil winding is that the inner turns (or separate coils) have less resistance, but a greater coefficient of self-induction than the outer turns, owing to the different diameters of the inner and outer turns, and hence the time constants of the separate windings are different.

For electromagnets three or four inches in length by two or three inches in diameter, to operate on 110-volt, direct-current circuit, the writer has had excellent results from six separate windings per spool, wound over each other, and connected in multiple as in Fig. 2. While Fig. 2 shows the terminals at opposite ends of the bobbin,

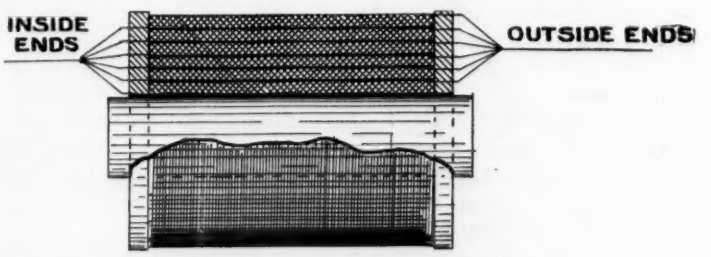


FIG. 2.—MULTIPLE-COIL WINDING.

by making the layers even in number, the terminals may all be brought out at the same end of the winding, as in Fig. 3. This arrangement produces the same general effect as six layers of coarser wire, with a corresponding decrease in voltage, and therefore is just as efficient, with the exception that there will be less copper in the fine wire winding owing to the greater ratio of insulating material on the fine wire. This ratio is illustrated in Fig. 4.

In order to ascertain the safe current carrying capacity of the

winding, a plain or regular winding may be assumed. As an example consider the bobbin in Fig. 5. The winding is to be connected directly across 110 volts direct current, and will be in use at such intervals that a radiating surface of 2 sq. in. per watt (not

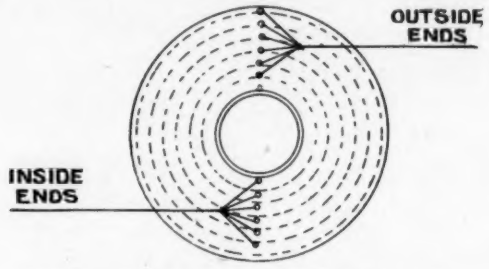


FIG. 3.—TERMINALS ON SAME END OF COIL.

considering end areas) will be sufficient to prevent an unsafe rise in temperature. The superficial area will then be $\pi D L$, in which D is the outer diameter of the winding in inches and L is the length

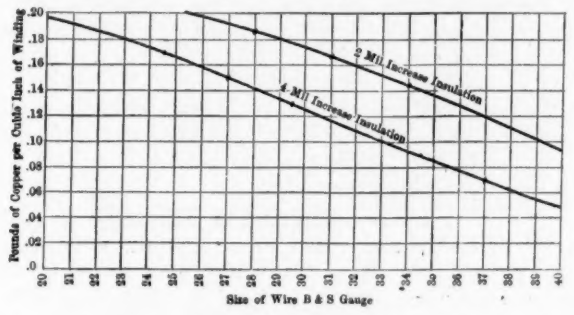


FIG. 4.—RELATIVE WEIGHTS OF COPPER IN DIFFERENT SIZES OF INSULATED WIRE.

of the winding, also in inches. Therefore, in this case $\pi D L =$ $3.1416 \times 2.5 \times 3.5 = 27.5$ sq. in., and hence $\frac{27.5}{2} = 13.75$ watts will be permissible for the winding. The resistance of the winding will then be $R = \frac{E^2}{W} = \frac{12{,}100}{13.75} = 880$ ohms.

Referring to Fig. 6, M is the mean or average diameter of the entire winding space, and Ma, Mb, etc., are the average diameters of the coils constituting the multiple-coil winding. Therefore, M

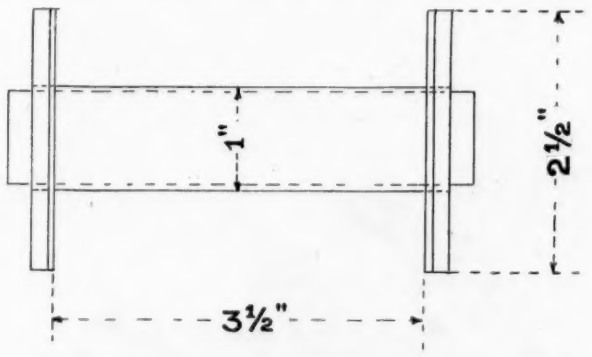


FIG. 5.—BOBBIN.

also represents the average of the mean diameters of the coils a, b, c, etc. If all the coils were of the same diameter, and hence of the same resistance, the joint resistance would be proportional to $\frac{M}{n}$, where n is the number of coils, 6 in this case. Although the mean diameters Ma, Mb, etc., are variable, they vary in a direct ratio to one another, and therefore by comparing $\frac{1}{n}$ of their "average mean diameter" with their "joint mean diameter," we may obtain a basis from which to compute the proper wire to use which shall give the desired resistance when the coils are connected in multiple. $\frac{1}{n}$ of the average mean diameter $= \frac{M}{n} = \frac{1.75}{6} = .292 = Ma$ (see Fig. 6). The joint mean diameter will be

$$Mj = \frac{1}{\frac{1}{Ma}+\frac{1}{Mb}+\frac{1}{Mc}+\frac{1}{Md}+\frac{1}{Me}+\frac{1}{Mf}} \qquad (1)$$

$$= \frac{1}{.889+.727+.615+.533+.471+.421} = \frac{1}{3.656} = .274.$$

Therefore, the ratio will be $.274 : .292 = .94 : 1$, which means that the joint resistance will be .94 times $\frac{1}{n}$ of the average resistance

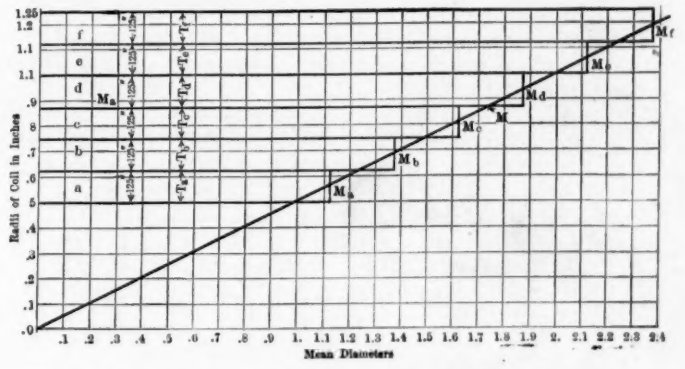


FIG. 6.—MEAN DIAMETER OF MULTIPLE-COIL WINDINGS.

of the coils, and since this latter is

$$Ra = \frac{Ra+Rb+Rc+Rd+Re+Rf}{n^2} \qquad (2)$$

the joint resistance

$$Rj = \frac{Mj\,(Ra+Rb+Rc+Rd+Re+Rf)}{Ma\ n^2} = \qquad (3)$$

$$\frac{.94\,(Ra+Rb+Rc+Rd+Re+Rf)}{n^2},$$

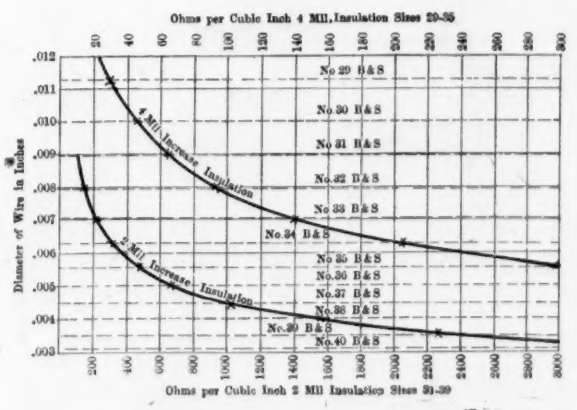

Ohms per Cubic Inch 4 Mil. Insulation Sizes 29-35
Diameter of Wire in Inches
4 Mil Increase Insulation
2 Mil Increase Insulation
Ohms per Cubic Inch 2 Mil Insulation Sizes 31-39

FIG. 7.—OHMS PER CUBIC INCH OF WINDING.

and since $Rj = 880$ and $n = 6$,

$$(Ra+Rb+Rc+Rd+Re+Rf) = \frac{880 \times 36}{.94} = 33{,}700;$$

therefore, the ohms per cubic inch $= \frac{33{,}700}{14.43} = 2{,}335$, which corresponds very nearly to No. 39 B. & S. wire with 2-mil insulation. (See Fig. 7.)

If paper is inserted between the coils and varnish used, a No. 39 B. & S. wire with 1.5-mil silk insulation would meet the requirements. Therefore, assuming the ohms per cubic inch to be 2,335,

and calculating the volumes of the coils separately, which are found to be 1.55, 1.89, 2.23, 2.58, 2.92 and 3.26 cu. in., respectively, the resistances will be 3,620, 4,410, 5,210, 6,020, 6,820 and 7,610 ohms, respectively. Their joint resistance will then be:

$$\frac{1}{\frac{1}{3620}+\frac{1}{4410}+\frac{1}{5210}+\frac{1}{6020}+\frac{1}{6820}+\frac{1}{7610}} =$$

$$\frac{1}{.000276+.000226+.000192+.000166+.000147+.000131} =$$

$$\frac{1}{.001138} = 880.$$

Now also the ratio

$$\frac{Mj}{Ma} = \frac{Mj}{\left(\frac{M}{n}\right)} = \frac{Mjn}{M} =$$

$$\frac{n}{M\left(\frac{1}{Ma}+\frac{1}{Mb}+\frac{1}{Mc}+\frac{1}{Md}+\frac{1}{Me}+\frac{1}{Mf}\right)}; \qquad (4)$$

and since $(Ra + Rb + Rc + Rd + Re + Rf) = Rs,$ (5)

$$Rj = \frac{n}{M\left(\frac{1}{Ma}+\frac{1}{Mb}+\frac{1}{Mc}+\frac{1}{Md}+\frac{1}{Me}+\frac{1}{Mf}\right)} \times \frac{Rs}{n^2} =$$

$$\frac{Rs}{Mn\left(\frac{1}{Ma}+\frac{1}{Mb}+\frac{1}{Mc}+\frac{1}{Md}+\frac{1}{Me}+\frac{1}{Mf}\right)}; \qquad (6)$$

and hence

$$Rs = Rj\,Mn\left(\frac{1}{Ma}+\frac{1}{Mb}+\frac{1}{Mc}+\frac{1}{Md}+\frac{1}{Me}+\frac{1}{Mf}\right). \qquad (7)$$

Therefore, to calculate the ohms per cubic inch, Rv direct, use the formula

$$Rv = \frac{Rj\,Mn\left(\frac{1}{Ma}+\frac{1}{Mb}+\frac{1}{Mc}+\frac{1}{Md}+\frac{1}{Me}+\frac{1}{Mf}\right)}{V} \qquad (8)$$

where V is the value of the total winding space in cubic inches.

In practice, paper or other insulating material is placed between the separate coils, since the total voltage is between adjacent coils, and hence the space occupied by the paper or other insulating material must be deducted from the total winding volume. It will be observed that the resistance of the inner coil, *a*, is only 3,620 ohms, while that of the outer coil, *f*, is 7,610 ohms, which is more than twice the resistance of coil *a*; therefore, there will be generated in the inner coil, *a*, twice as much heat as generated in the outer coil, and hence if the proper resistance is not provided, coil *a* will get very hot unless there is a sufficient mass of core material to conduct away the heat to be radiated from the frame.

Instead of calculating the "ohms per cubic inch" for the wire used in the multiple coil winding, a regular winding of one coil may be assumed, and the diameter of the wire Δ found by comparing the "ohms per cubic inch" with the diameter of the wire in Fig. 7.

The diameter of the wire for the multiple winding will then be

$$\Delta s = \frac{\Delta}{\sqrt{n}}. \qquad (9)$$

As this is only an approximate method, it is best to assume 4-mil insulation for the regular winding, and 2-mil or 1.5-mil insulation for the multiple-coil winding. To determine the proper size of wire (4-mil increase insulation in this case) the "ohms per cubic inch" must now be found, which of course are equal to the resistance divided by the volume of the winding in cubic inches.

The volume of the winding (see Fig. 5) will be $\pi M L T$, where M is the mean or average diameter of the winding and T is the winding thickness or depth.

In the case considered $\pi M L T = 3.1416 \times \left(\frac{2.5+1}{2}\right) \times 3.5 \times \left(\frac{2.5-1}{2}\right) = 3.1416 \times 1.75 \times 3.5 \times .75 = 14.43$ cu. in., and the "ohms per cubic inch" will be $\frac{880}{14.43} = 61$. A glance at Fig. 7 shows that the nearest B. & S. copper wire with 4-mil insulation is No. 31.

Formula (9) is derived from the fact that in any case the resistance per unit volume for any wire is inversely proportional to the fourth power of the diameter of the wire. (The presence of the insulation varies this somewhat as Fig. 4 will show, so formula (9) is only approximate.) And since $Rs = n^2R$ (approximately), $\Delta s^4 = \frac{\Delta^4}{n^2}$, where $\Delta s = \frac{\Delta}{\sqrt{n}}$.

Here Δ is the diameter of the wire in the regular winding, and Δs represents the diameter of the wire in the multiple-coil winding.

This may be verified by referring to the examples worked out, and to Fig. 7.

Rise of Niagara Power.

HYDRAULIC developments for power purposes about Niagara Falls represent neither an invention nor a revolution, but a growth. Substantially every type of hydraulic construction in the great plants now nearing completion has had a forerunner on an humble scale. Wheel pits and tunnels, canals and pipes, horizontal wheels and vertical shafts, stations above the falls and stations in the gorge below, have been repeatedly constructed on different scales as the engineering arts and the methods of power distribution have advanced.

Perhaps the first industrial application of Niagara power was that in the sawmill built by the French in 1725, on the New York bank of the river near the upper rapids, for the purpose of making lumber to be used in Fort Niagara. From the date just named down to about 1800 sawmills appear to have been constantly in use along these rapids. Augustus Porter built a sawmill on the New York bank of the upper river in 1805, and two years later Porter and Bacon erected a gristmill near the same location. It seems probable that small heads of water were obtained at these mills by means of short canals approximately parallel with the river bank. From about 1822 to 1885, in which latter year the mainland opposite Goat Island was taken as a part of the New York State Park, a canal ran from near the head of the upper rapids down toward the American Falls, and mills were built between this canal and the river. In these rapids there is a fall of about 50 feet, and a part of this head was utilized by taking water from the canal to the wheels, and then discharging it into the river above the falls. Bath Island lies between the New York bank and Goat Island, and was the site of a paper mill as early as 1825. This mill, destroyed by fire in 1858, was replaced by another which met a like fate in 1882, and the third mill seems to have been in operation on this island when it was taken for the state park in 1885. Five tons of paper was the daily production of the second mill. The third mill had turbines of 400 hp capacity. The head of water for these wheels could have been no more than the fall of the rapids along the sides of this small island. As late as the year last named there was standing between a canal and the river, a little above the Cataract House, a gristmill of Witmer Brothers, built in 1822, which operated with three turbine wheels. Not far from the Cataract House a wing dam ran out into the rapids and diverted water into a short canal, as late as 1882, and between this canal and the river were several mills with turbine wheels that had an aggregate capacity of at least 525 hp. The largest of these mills was that of Hill & Murray, where 10 tons of wet pulp were manufactured daily with the aid of turbines of 400-hp capacity. From this same canal, in 1879, water began to be taken to operate a Brush arc dynamo with a capacity for twenty 4,000-cp lamps. The dynamo was driven by a 33-in. turbine wheel of 36-hp capacity under the water head of 12 ft. Prospect Park and the Falls were lighted

by arc lamps equipped with reflectors and connected to this dynamo. Thus it seems that before 1885, when the state park displaced most of these mills, the rapids above the American Falls were operating turbines with a total capacity of about 1,000 hp, at heads much less than the 50 ft. which these rapids might have been made to furnish. Water used for this power development was returned to the river above the crest of the Falls. Meantime the diversion of water above the Great Cataract, and its discharge into the gorge below for power purposes, had already begun. As early as 1842 Augustus Porter proposed a canal to lead water from the upper Niagara River to the gorge, and in 1853, the Porter family granted the Niagara Falls Hydraulic Co. a plot of land having a frontage of 425 ft. on the upper river, extending for nearly a mile along the Gorge below the Falls, and with a width of 100 ft. in a strip 4,400 ft. long between these river frontages. The object of this grant was to secure the construction of a canal from a point above to one below the Falls, so that mills might locate at the lower end of the canal and have a high head of water. Excavation of this canal began with a celebration in 1853.

Completion of the work was delayed for lack of funds, but Horace H. Day secured the property in 1860, and, on July 1, 1861, finished the canal with a length of 4,400, a width of 36, and a depth of 8 ft. This canal terminates in a basin near the top of the Gorge with a water surface of 210 ft. above that of the river below. Further development was arrested at this time by the Civil War, and it was 1870 before any of the great power thus made available was utilized. About that time the Gaskill gristmill was built at the lower end of the canal. This mill appears to have been equipped with turbines of 100-hp capacity under not less than 25 ft. head. In 1877 the canal just mentioned and the river frontages at its upper and lower ends were purchased by the Niagara Falls Hydraulic Power & Manufacturing Co., and Schoellkopf & Matthews began the erection of a flour mill to utilize a part of the power in the same year. This mill was located at the top of the cliff near the lower end of the canal, was 64x126 ft. on the ground in its main part, six stories in height, and was equipped with two American turbine wheels with a combined capacity of 900-hp under a head of 50 ft. Water was carried down to these wheels through a boiler-iron pipe 9 ft. in diameter, and this development had the highest head and the greatest power capacity of any that had been made at Niagara Falls up to that time. The original Gaskill mill, that of Schoellkopf & Matthews nearby, and all those erected at the end of the canal in question for about twenty years utilized the water power by sinking wheel pits in the cliff and then excavating a nearly horizontal tunnel from the bottom of each pit to the face of the cliff in the Gorge. Turbine wheels were located at the bottoms of these pits, the water from the canal after passing through the wheels was discharged from the tunnels, and a vertical shaft from each wheel delivered its power at the top of the cliff. All of these wheel pits were excavated before turbine wheels for heads of 100 ft. and over could be readily procured, and the depths of the pits ranged approximately between 25 and 90 ft. Water being thus discharged into the Gorge high up on the face of the cliff, the greater part of the power that might have been obtained from it was wasted. In 1881, one of the wheel pits in question was sunk to a depth of 86 ft. below high water level in the canal, and was given an area of 20x40 ft. From the bottom of this pit a tunnel 160 ft. long and 10x6 ft. in cross-section was cut to the face of the cliff. In the pit three 45-in. turbine wheels were placed, and each of these wheels, rated at 1,000 hp, was supplied with water through an iron penstock seven ft. in diameter. About one year earlier than this, in 1880, the Cataract Manufacturing Co. installed a 48-in. American turbine in a pit of sufficient depth to give a water head of 83 ft. to furnish 1,300 hp for the manufacture of wood pulp. The two wheels first installed quickly broke under the head just named, but the third was of much greater strength and able to withstand the pressure. For this 48-in. wheel a circular pit 8 ft. in diameter was excavated through the rock, and from the bottom a tunnel 6 ft. in diameter was cut to the face of the cliff. The wheel was placed on the ledge at the bottom of the pit, which filled with water during operation, and the vertical shaft was braced at intervals by stays across the pit. A distinct advance in the use of high water heads at Niagara Falls was made in the two pits last named, and what was there done has been repeated on a larger scale in some of the recent power work. A number of pits besides those named were sunk from time to time along the top of the cliff at the lower end of the canal, and the discharge from their tunnels creates a miniature Niagara even to this day.

During the winter, water falling from the tunnel outlets freezes before it reaches the river, and forms a small mountain of ice in the Gorge. In 1899 the aggregate capacity of the water wheels supplied by the canal and mechanically connected to the machinery of manufacturing plants along the cliff was 7,523 hp.

Among these plants was that of the Cliff Paper Company, especially notable as the first to utilize substantially the entire head of Niagara Falls, and the first to be located in the Gorge. This company operates a paper mill at the top of the cliff, and a pulp mill at its foot, at the edge of the river. After passing down a wheel pit in the cliff and driving turbines under a head of 75 ft., the water for the pulp mill goes into an iron penstock and drops another 125 ft. to horizontal Leffel wheels that develop about 2,500 hp. From the tail race of these wheels the water flows directly into the river. This pulp mill in the Gorge was erected and operating before either of the great electric stations at Niagara Falls were built, and prior to 1895, only two of these stations, one on the American and another on the Canadian side of the river, have since followed it to the foot of the cliffs. One of these stations, that of the Niagara Falls Hydraulic Power & Manufacturing Co., close to the pulp mill of the Cliff Paper Co., began to generate electric power in 1896, with horizontal turbines operating under a water head of 210 ft. from the canal above. This was the first electric station to locate in the gorge.

During the previous year another plan for the development of power with the combined head of the Falls and upper rapids had been carried to completion in the plant of the Niagara Falls Power Company. Between 1883 and 1885, Thomas Evershed, an engineer engaged in the survey of the Niagara Falls Park Reservation, proposed a tunnel running beneath the city of Niagara Falls, and a system of canals and wheel pits, for the purpose of power production. The tunnel was to have a length of about 2.5 miles, was to connect with smaller tunnels, and was to vent at water level in the Gorge, just north of the reservation. Main and branch canals were to divert water from Niagara River above the upper rapids, and to deliver it in wheel pits along the lines of tunnels, for turbine wheels located on the pit floors. A company was formed to carry out this idea in a revised form, under which the wheel pits were brought close together and electric distribution of power was to take the place of branch canals and tunnels. For the development of electric energy the generators were to be mounted at the tops of vertical shafts that rose from turbine wheels near the bottom of each pit. The plan finally adopted included a surface canal 250 ft. wide at its head on the river front, 1.25 miles above the American Falls, 1,700 ft. long in a direction approximately at right angles with the river, and 12 ft. deep. On either side of this canal a wheel pit was to be excavated to a depth of 178 ft., and a tunnel 7,436 ft. long was to connect the bottoms of the pits with the river in the gorge below the Falls. The tunnel width was 18.82 ft., its height 21 ft., and its area in cross-section 386 sq. ft. Ground was broken for this development on October 4, 1890, and the first sale of electric energy was to the Pittsburg Reduction Co. for the production of aluminum on August 26, 1895. The canal and tunnel were designed for a capacity of 120,000 hp., at the head of 136 ft. utilized in the first wheel pit. In the great wheel pit and tunnel of 1895 may be seen an extension of the plan followed in the hydraulic development for the Gaskill mill more than twenty years earlier. Each plant included a canal to bring the water from the upper river, a wheel pit with turbines at the bottom, a vertical shaft rising from each wheel to the ground level, and a tunnel to discharge the tail water into the gorge. In the later development, however, the tunnel is more than a mile instead of only a few feet in length, the head is 136 to 150 ft. instead of 25, and the capacity is 120,000 instead of 100 hp.

The plant of the Niagara Falls Power Company set the pattern for electric stations with wheel pits and tunnels, and the Niagara Falls Hydraulic Power & Manufacturing Co., by locating its generating equipment at the foot of the cliff, in 1895, fixed a type for those who run pipes down into the Gorge and connect them with horizontal turbine wheels for the operation of electric generators. Both of these examples on the American side of Niagara River have been followed on the Canadian bank. In Queen Victoria Park the generating plants of the Canadian Niagara Power

Co. and the Toronto Niagara Power Co. are reproductions of the electric stations with tunnels, wheel pits and vertical shafts on the New York bank, with such minor improvements as experience has dictated.

In the Gorge, close to the foot of the Horseshoe Falls and diagonally across the river from its American prototype of ten years ago, is the new plant of the Ontario Power Co. This plant, like that of the Hydraulic Power and Manufacturing Co. across the Gorge, takes water above the upper rapids, leads it from the top to the foot of the cliffs in steel pipes, passes it through horizontal turbines that are direct connected to their electric generators, and discharges it into the lower river. While the much larger and later plant of the Ontario Power Co. presents many modifications of detail, perhaps its most striking departure from its prototype is in the use of a steel pipe line instead of a canal to bring the water to the top of the cliff.

Overhead vs. Underground Central Station Circuits.

In a paper entitled "Overhead Versus Underground Lines," read at the meeting last week of the Illinois State Electrical Association, Mr. H. B. Gear discussed the relative advantages and disadvantages of overhead and underground wires with especial reference to the conditions existing in medium-sized cities.

Overhead lines have been employed almost exclusively by central station companies in all except the larger cities, principally because with this system a given amount of business can be transacted between generating station and consumer with a minimum investment. Indeed, were it not for the availability of this system there would be no central station service in the majority of the smaller cities. In this connection it may be remarked that the possibility of maintaining overhead lines at small cost has no doubt led some central station managers to make their construction so cheap that it has become a source of unreliable service and a menace to life and property. This state of affairs has no doubt been one of the factors in creating a public sentiment in favor of underground distribution.

The maintenance of overhead lines is comparatively easy owing to the ready accessibility of such lines for inspection at all times. The exposure of overhead lines, however, subjects them to a high rate of depreciation on account of the action of the elements. Continuity of service cannot even be approximated with overhead lines in a distributing system of any considerable extent, no matter what precautions are taken or how good the construction. This becomes a serious matter in cases where considerable amounts of power are being distributed for manufacturing purposes over such lines, as interruption of service means loss not only to the central station company but to the consumer, whose employes are standing idle while the service is off. The discharge of lightning arresters, the occurrence of grounds in the limbs of trees and elsewhere, the swinging of wires in high winds during a storm, all are sure to interrupt service on every part of the system at one time or another. It is usual for the telephone lines to be carried on the same streets with the electric lighting lines. There are, therefore, many places where one set of wires pass under or above the other. In time dangerous situations are apt to result from this condition, in case the upper set of wires breaks and falls across the lower.

The principal advantage of underground construction, aside from æsthetic considerations, is that, where employed for reasonably large areas, it relieves the central station manager of the troubles that beset his overhead lines in stormy weather, and continuity of service may, therefore, be more nearly approximated. The maintenance of underground lines which have been installed in accordance with approved methods is comparatively simple, the necessity for repairs being less frequent than on overhead lines. However, when trouble does occur, it is usually of such a character that a longer time and more expense is required to make repairs.

The installation of underground services is also troublesome where sidewalks or basements are unexcavated. Laterals cannot be put into every building on account of the prohibitive expense and it is, therefore, necessary for consumers in whose buildings there are no laterals to extend their wires outside their own premises as much as 50 to 75 ft. in some cases.

The failure of the insulation of cables near points where connections are made between overhead and underground lines is apt to be troublesome, especially where the length of the underground system is short (less than 400 ft.) on account of the action of lightning. It is, therefore, necessary to provide lightning arresters near all cable poles. On such combination systems, where the underground work extends over a considerable area, this trouble, however, is not so likely to be experienced. The failure of joints between overhead and underground lines on cable poles due to the action of the elements is also a detail which has proven quite generally troublesome. It is difficult to protect the grounded sheaths of the lead cable so that it is safe for linemen to work on the pole without introducing other elements of construction which are equally dangerous to continuity of service.

In order that some idea may be had of the elements entering into the cost of underground construction, a typical underground system, such as might be required for a city of 15,000 to 25,000 will be taken. The use of underground lines for general distribution in scattered residence territory is prohibitively expensive and will, therefore, not be considered.

In the case assumed large manholes are provided at street intersections for the purpose of allowing ample room for the installation of transformers, jointing of cables, etc. Smaller manholes are provided at points where laterals are installed for services. Four ducts have been provided, although only two of them are occupied by the primary and secondary cables which have been included in the estimate. The average central station has some series arc or 500-volt power service which would occupy the two remaining ducts, and though these were not occupied by such circuits, it would be advisable to install them for future use. The additional expense of two ducts at the time the conduit line is being laid is small as compared with what it would be if it was desired to lay additional ducts later on, and conduit work is subject to a very low rate of depreciation.

The primary cables are of No. 6, as this is the smallest size which it is practical to use for mechanical reasons. The secondaries have been figured on the three-wire system, the copper being No. 2 B. & S. throughout. This perhaps would not be the practice as there are usually large blocks of load concentrated in the immediate vicinity of transformers which make larger cable necessary at these points and permit the use of smaller cable at other points. However, the net result would be about the same from the standpoint of investment as if No. 2 wire were used throughout. Transformers of 15 to 25 kw capacity are assumed to be required to carry the load, a total capacity of 125 being assumed. The value of transformers is not included in the figures given as they would be the same for either overhead or underground construction.

The cost of installing the system above described, assuming that it were done as a job of undergrounding overhead lines, would be about $9,000,000, the items being as follows:

3,425 linear feet of four-duct conduit line at $1.25	$4,300.00
Six 5x5 manholes, at $100.00	600.00
Thirteen 3x3 manholes, at $45.00	585.00
1,500 linear feet of iron pipe laterals, at 40 cents	600.00
10,000 feet of No. 2 cable, at 14 cents	1,400.00
5,000 feet of No. 6 cable, at 11 cents	555.00
3,500 feet of service cable, average No. 4, at 11½ cents	400.00
Junction boxes and incidentals	300.00
Labor of installing cable and services	300.00
Total	$9,040.00

The cost of overhead lines of equivalent capacity to distribute the load provided for in the above described underground system would not be over $2,000, using the best construction. The investment required for underground construction in a business district may therefore be taken as being from four to five times as great for overhead construction.

Having before him estimates of the cost of placing his overhead lines underground, the central station manager is confronted with the problem of determining whether or not the income from the consumers supplied in the territory under consideration will warrant an increase in the fixed charges resulting from the investment necessary to place his lines underground. There being no great saving in the maintenance charges, the question resolves itself into one of determining whether the greater degree of continuity of service will offset the increased expense in fixed charges. Or, in case the line has been ordered placed underground by municipal authorities, it is a question of determining whether it would be better to lose the business than to incur the additional expense due to the underground investment.

For example, in the case illustrated above, assume that the maximum load of 125 kw is used three hours per day during 300 working days per year. The current consumption of the district would then be 112,500 kw-hours. The interest and depreciation on the investment of $9,000, figured at 15 per cent amounts to $1,350. The cost of supplying customers in this district would therefore be 1.2 cents per kw-hour more than it is with overhead lines. If the average daily use of current were two hours instead of three, the consumption would be correspondingly less, and the increased cost of current in this district would be 1.8 cents per kw-hour.

If this were residence territory with a maximum load of 20 kw, the investment in underground work would be only slightly less, says $7,500. If the maximum load of 20 kw were used on an average of three hours per day, the annual current consumption would be 18,000 kw-hours with fixed charges of $1,125. The cost of current delivered to this territory, due to placing the wires underground, would then be about 6 cents per kw-hour more than with overhead lines. This cost would, of course, vary with longer or shorter hours use of the current, but this figure would perhaps represent average conditions in first-class residence territory. Having determined the increased cost per kw-hour due to the undergrounding of these lines and knowing his other costs, the central station manager can readily determine whether or not the proposed investment in underground work will be warranted.

In cities which are laid out with alleys, the expense of going underground may often be avoided by moving the pole line into the alleys where their presence is not objectionable and where the overhead services to buildings can still be maintained. Much can be done in the way of mollifying the public demand for underground work by keeping main pole lines out of the business district as far as possible and keeping all pole lines on business streets in first class condition.

The Graphitized Filament Incandescent Lamp.

Our London contemporary, the *Electrician*, prints the following abstract of an English patent just issued having for its subject the new type of incandescent lamp filament which formed the subject of a paper read by Mr. John W. Howell at the recent Asheville meeting of the American Institute of Electrical Engineers:

An ordinary base filament is heated in a carbon tube furnace to a very high temperature. This firing is preliminary to the final firing after the filament has been "treated" or "flashed" and is done for reasons which will be explained later. The firing is done by placing the filaments in bundles in small capsules, tubes or boats and passing these boats through the carbon tube furnace. If desired the filaments may be packed in carbon dust. The time of passage of the filaments through the furnace may be widely varied. Good results have been obtained by firings varying anywhere from 20 or 30 minutes to a number of hours. The carbon tube furnace may be of any suitable construction, but it has been found best to use an ordinary tube of carbon of about 3 in. outside diameter and 1¼ in. inside diameter. One tube used was packed in carbide of titanium and had asbestos or other plugs at either end and water-cooled clamps for introducing and taking out the currents. The current used with a tube of the above dimensions may be in the neighborhood of 1,900 amp., and involves the expenditure of energy at the rate of about 23 kw. This power can conveniently be obtained from the secondary of an alternating-current transformer.

After the base filament has received the preliminary firing in the electric furnace it is subjected to the ordinary "flashing" or "treating" process, whereby it receives a coating of what is believed to be graphitic carbon, and is again put into the carbon boats or receptacles and passed through the carbon tube furnace; in this second firing the furnace may be run at the same temperature as that corresponding to the first firing. It was attempted to measure the temperature by observing an incandescent filament placed in the line of vision with the furnace interior and then equalizing the luminosity of the filament with that of the furnace interior. After making this adjustment it was found that with the furnace at the usual temperature this filament was running at about double its normal voltage. Thus, if a 50-volt incandesceent lamp be employed, then for the purposes of this measurement the lamp is found to run in the neighborhood of 100 volts. The temperature was calculated from the law of Lummer, that at high temperatures the ratio of luminosity of a filament equals the twelfth power of the ratio of the absolute temperatures. Assuming that the filament of the incandescent lamp had the same temperature as the interior of the furnace this makes the range of temperatures used in the furnace between 2,300° C. and 3,000° C. These temperatures as measured in the above manner check with the readings of temperatures of the furnace obtained by the use of an instrument known as the Wanner spectrophotometric pyrometer. The minimum limit of furnace temperature at which the beneficial effects of the invention are obtained, it is difficult to state with certainty though it is believed the results cannot be obtained below 2,000° C. It is certain that for the best results the temperature must be at or above a temperature much higher than this and at which quartz, platinum and the rare oxides vaporize and disappear. The carbon tube of the furnace, at these most extreme temperatures, does not last more than a few hours and must then be renewed.

It has been found that the change which is produced in the "flashed" or "treated" filament by firing in the furnace is one which takes place in the shell or coating, produced by the "treating" or "flashing" process, while practically no change or, at least, comparatively little change is produced in the base filament upon which the coating or "flashing" is applied. A section of the shell or coating of the filament 1 in. or more in length may, without difficulty, be removed from the ordinary 16-cp filament, and when removed is found to consist of a little tube with very thin walls. The material of this tube is believed to be a new form of graphite. It answers certain chemical tests for graphite, as, for example, by producing graphitic acid when treated with highly oxidizing reagents in a manner well understood by chemists, and gives the characteristic graphite lustre when rubbed on paper. It is furthermore extremely tough and flexible, to illustrate which the little microscopic tube may be readily pressed perfectly flat with the blade of a knife, and will thereafter resume its original form.

With respect to its specific resistance, this of course may vary, depending upon the temperature at which it was fired, but in any case is extremely low. Its resistance for a given unit of 1 meter long by a square millimeter section varies from 0.6 to 1.6 at a temperature of 20° C. while Zellner ("Die Künstlichen Kohlen," p. 251, published by Julius Springer, Berlin, 1903), in the same units, gives the resistance of ordinary carbon as 20 to 50, Ceylon graphite 2 to 8, and Acheson artificial graphite 12. The material is non-magnetic, and has a metallic lustre. Its specific gravity is considerably higher than that of either graphite or carbon, and in one sample tested was found to be in the neighborhood of 1.96. The tube above referred to is believed to consist entirely of the new form of carbon above mentioned, and constitutes a hollow filament which can be and has been mounted as the filament of a lamp. It is usually found more convenient to use the composite filaments consisting of a core of ordinary carbon and a shell of the new form of carbon as fully described above.

In describing the best mode known of carrying out the invention, there has been prescribed a firing of the base filament prior to "flashing" or "treating" thereof and a subsequent firing after the "flashing" or coating obtained by treatment in the hydrocarbon has been applied. This double firing obviates or prevents the appearance of minute bubbles or blisters on the surface of the filament as may occur when there is no preliminary firing of the base filament. These bubbles have the appearance of being caused by gas pressure developed within the filament while the coating or "flashing" is in a pasty condition. It is probable that the bubbles are caused by the effort of impurities, metallic or otherwise, to escape from the base filament through the coating or "flashing." The preliminary firing of the base filament by removing to a greater or less extent these impurities has been found to have the effect of preventing the appearance of these bubbles in the filament. The double firing of the filament, however, results in a somewhat different appearance in the completed article. With a single firing of the "flashed" filament the surface is black and shiny, although apt to be marred by the presence of bubbles or blisters. With the doubly-fired filament, once before "flashing" or "treating" and once after, the surface of the filament is free from bubbles and may under certain conditions have a greyish velvety appearance. It is considered best to raise the temperature of the filament rather slowly in the first firing, to

avoid a weakening of its structures due to a too sudden escape of gas.

Other filaments than squirted cellulose filaments have been treated in accordance with this invention with similar results. It has been found that by taking an ordinary base filament and coating it with hydrocarbon, as by dipping in asphaltum, and then firing in the furnace at the high temperatures hereinbefore mentioned, results similar to those characteristic of the "flashed" filament can be obtained. That is, there can be obtained a filament the specific resistance of which is much less than that before firing and the temperature resistance coefficient of which either approaches or becomes a positive value.

It is thought at present that the impurities in the base filament, probably the potassium, on being driven out by the heat of the electric furnace unite with the graphite coating or "flashing" and enable it to soften and form some combination which is at present unknown, perhaps a simple potassium carbon solution. Whatever this impurity may be, it is subsequently driven off, leaving the particles of the resultant graphite or carbon associated with each other in a relation very much closer than the relation in which they are associated in all forms of carbon hitherto known, and much more analagous to the manner of association of the particles in ordinary metal. This theory, if correct, would account for the lustre and density, the high specific gravity, the strength, the elasticity, etc., of the new form of carbon which differentiate it from all other forms of carbon now known.

New Telephone Patents.

SELECTIVE SYSTEMS.

While it would seem that almost every conceivable form of selective principle had been employed by inventors, still every few weeks brings out some new means of attack. This week we have a synchronized pendular arrangement patented by D. F. Laughlin, of Clyde, Kan.

In this system a series of adjusted pendulums are provided for the operator, each of the series having a period corresponding to one and only one of the stations on each line. Thus, for four-party working, four characteristic pendulums are required. The key or operator's pendulums, are arranged to control electric circuits, impressing on the line currents, say, during their forward strokes and cutting this off on the backward stroke. Normally at each station an electromagnet is connected to the line at each station, in the field of which the selecting pendulum is suspended. If the operator starts a pendulum a series of pulls will be exerted upon all station pendulums, but these will be synchronized with one only, which will respond with constantly increasing amplitude of vibration. In the path of the station pendulum is a trip bar, which becomes unlatched by being struck by the vibrating pendulum when the amplitude becomes sufficient. This trip bar closes the talking circuits and cuts off the vibrator circuit. The restoring of the hook switch resets the trip bar.

Another selective system has been patented by S. M. Gant, of Indianapolis. In this system selection is made at a distant central point of line center, between any one of a group of branch lines. Three lines are required for the main line and these are connected to a set of relays at the line center. By manipulating three switches or their equivalent, in proper sequence, the relays being interconnected, almost any combination of operated and non-operated relays may be obtained, each combination serving to control the connection of one branch line with the main line.

TELEPHONE CARRYING CASE.

For testing purposes it is often necessary to carry about a telephone set, and Mr. A. G. Davis, of Baltimore, has patented a carrying case and support. The bottom of the case carries transmitter and receiver supports, and to this bottom is secured leather or cloth flaps, with the usual eyelets and fasteners, so that the whole may be closed up like a wallet. Metal hooks on one flap serve as a means of hanging up the set when opened for use.

MULTIPLE SWITCHBOARD CIRCUIT.

In 1899 and 1891, respectively, Mr. M. G. Kellogg, of Chicago, applied for two patents for switchboard devices, which have just been issued. One of these describes the arrangement of clearing out and line drops with which cut-off jacks may be dispensed. Mr. Kellogg permanently bridges the line drop to ground and makes it of so high impedance as not to affect the talking circuit. He bridges the clearing-out drop to ground also, and while this prevents disturbance of the talking, yet for ringing currents its effective resistance is so low that the high-wound line signals are too much shunted to operate.

The second patent describes the use of pulsating ringing current for the selection at will of either to polarized drops. Both these patents are assigned to the Kellogg Switchboard & Supply Co. The ideas on both were probably developed in the production of the Kellogg divided multiple system.

INTERCOMMUNICATING SYSTEM.

Messrs. A. K. Andriano and H. Herbstritt, of San Francisco, have jointly patented a lockout intercommunicating system, which is quite ingenious. When one party desires a second, he sets his indicator and rings. If the desired station be not busy this combined act will connect the desired party to the line and signal him. If, however, he be busy, through the agency of electromagnets, the calling party will be apprised of the fact by a humming produced in his telephone. Similarly, if any station try to listen to a conversation, the connecting of himself will be to a busy line and hence he receives the buzzing noise. The patents for this system have been assigned to the Direct Line General Telephone Co., of San Francisco.

LETTER TO THE EDITORS.

Approximation of the B. & S. Gauge.

To the Editors of Electrical World and Engineer:

SIRS:—In connection with the article by Mr. C. P. Nachod on "Some Approximations of the B. & S. Gauge" in your issue for September 23, allow me to offer an application of one of the formulæ presented, which may be of service to some of those who find the slide rule often closer at hand than a table of wire sizes.

From Mr. Nachod's formula,

$$cm. = \frac{20 - \frac{n}{3}}{10}, \qquad (1)$$

the familiar formula for the sizes of wires on direct-current systems becomes

$$\frac{10.8 \times 2D \times I}{V} = \frac{20 - \frac{n}{3}}{10}, \qquad (2)$$

where D = distance in feet to load,
I = current in amperes,
V = drop in volts.

Formula (2) can be reduced to

$$\frac{216 \times D \times I}{V} = \frac{2^{20}}{2^{\frac{n}{3}}}, \qquad (3)$$

$$2^{\frac{n}{3}} = \frac{2^{20}}{216} \times \frac{V}{D\,I}, \qquad (4)$$

or approximately,

$$2^{\frac{n}{3}} = 5{,}000\,\frac{V}{D\,I}; \qquad (5)$$

and

$$n = 3\,\frac{log\ 5{,}000\,\frac{V}{D\,I}}{log\ 2}, \qquad (6)$$

or approximately,

$$n = 10\left(log\ 5{,}000 + log\,\frac{V}{D\,I}\right) \qquad (7)$$

$$n = 36.99 + 10\,log\,\frac{V}{D\,I}. \qquad (8)$$

This formula, which will give the size of wire directly, is accurate to the nearest B. & S. size, and is much easier to handle than may seem to be true at first glance. The calculation often reduces to simple numbers, and at most requires the reading of only one logarithm on the slide rule.

As an example, let the distance be 100 ft., the current 100 amp., and the drop 10 volts. Then $\frac{V}{D \times I} = \frac{1}{1{,}000}$, and $n = 36.99 - 30 = 6.99$; i. e., between No. 6 and No. 7. The ordinary solution indicates 21,600 circular while No. 6 and No. 7 have 26,250 and 20,816 circular mils, respectively.

A second example may be given to show the accuracy of the formula when dealing with larger wires. Let $D = 200$, $I = 500$, and $V = 10$. Then $\frac{V}{D \times I} = \frac{1}{10{,}000}$. $n = 36.99 - 40.00 = -3.01$; i. e., about No. 0000. The ordinary solution calls for 216,000 circular mils, while No. 0000 has an area of 211,600 circular mils.

DETROIT, MICH. W. F. WHITE.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Brush Holder.—An illustrated description of a new brush holder made by a British company. The spiral spring which serves to exert a uniform pressure of the brush on the commutator is totally enclosed in the cartridge-shaped arm of the brush-holder, and is thus out of the way of dust and accidental injury. The milled nut, *A* (Fig. 1), when screwed further into or out of the hollow brush-

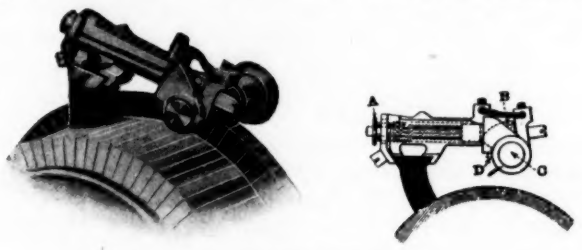


FIG. 1.—BRUSH HOLDER.

holder arm, serves to adjust the pressure of the spring. The latter presses against a small plunger which abuts, at one end, against the face of the cam, *B*, securely clamped to the brush spindle, *C*, while its other end passes through the hollow nut, *A*. When the brush wears down to become useless, the small projection, *D*, comes in contact with the head of the plunger and prevents the brush from descending further. Hence the metal parts of the brush-holder cannot possibly damage the commutator. The cam, *B*, is of such a shape that the brush, when lifted off the commutator, remains in this position, thus allowing any adjustments necessary and facilitating the renewal of the brush.—Lond. *Elec.*, Sept. 22.

Variable-Speed Alternating-Current Motor.—REYVAL.—An illustrated description of two machines exhibited by the Société Alsacienne. One machine is a commutator motor designed for three-phase currents at 110 volts and 50 periods. Its normal speed at no-load is 1,000 revolutions, and its normal power 20 to 25 hp. It is operated in combination with a small booster which gives changes of voltage between 25 and 195 volts. The stators of both machines are connected in parallel with the network. The rotor of the motor and the movable portion of the booster can be connected so that their e.m.f.'s are either (1) in opposition or (2) in series. In both cases the speed is regulated by varying the potential difference between the three brushes of the motor. In the first case (1) the maximum speed of the motor is that of synchronism (1,000 revolutions for six poles and a frequency of 50 periods per second) the speed diminishes when the counter e.m.f. produced by the booster increases. In the second case the maximum speed is far above the speed of synchronism and is the greater, the greater the e.m.f. of the booster added in series to that of the motor. The motor which may also be operated as a repulsion motor by single-phase current has all the good qualities of the direct-current series motor. There is no sparking at the commutator.—*L'Eclairage Elec.*, Sept. 9.

Liege Exposition.—Illustrated descriptions of direct-current and alternating-current generators, motors and transformers exhibited by the Westinghouse Company, especially railway motors, motors for steel works, and other apparatus.—*L'Eclairage Elec.*, Sept. 16.—A description of a direct-current, 475-kw, 550-volt Lahmeyer dynamo, running at 150 revolutions per minute and driven by a Diesel engine. Both the dynamo and the engine are described in detail and illustrated.—*L'Eclairage Elec.*, Sept. 23.

Commutators.—LEES.—An illustrated article on the maintenance of commutators and brushes, giving practical rules and describing various commutator appliances.—Lond. *Elec. Eng.*, Aug. 25 and Sept. 1.

LIGHTS AND LIGHTING.

Church Lighting.—An illustrated description of the lighting installation of the new cathedral in Berlin, Germany. Indirect illumination is made use of. Arc lamps are arranged in hidden places above the cornices in the main cathedral, on the galleries of the cupola, which by reflectors distribute the light uniformly throughout the vast hall. These effects are added to by illuminants of the same kind, throwing their light upwards from magnificent candelabra placed in the aisles, and preventing the formation of any disturbing shadows. With the light of these arc lamps, softly diffused from the roof, is mixed that of hundreds of glow lamps mounted on the same candelabra, as well as on brackets and chandeliers. The electric lighting plant includes at present about 1,900 incandescent lamps of 15 to 25 normal cp, upwards of 100 Nernst lamps and about 70 arc lamps of 6 to 15 amperes. The motive power plant includes 6 electric drives, one of which (10 hp) actuates the organ blowers, while two 9-hp motors are set apart for the bell work and the remainder for fans and a lift. The organ motor works at 1,175 r.p.m. on a high-pressure blower yielding 96 cu. meters per minute at a pressure of 200 mm. water column in the organ reservoir, and is actuated by a starter placed close to the keyboards.—Lond. *Elec. Review*, Sept. 22.

POWER.

Direct-Current for Power Distribution.—AYRTON.—A lecture delivered before the British Assoc. Adv. of Science on the distribution of power. The author "preaches heresy," speaking in favor of the use of high-tension, direct-current for power transmission and distribution. Its advantages over alternating-current are less liability of breakdown of insulation, since from the point of view of economical transmission 60,000 effective volts alternating means exactly the sasme as 60,000 volts direct, while from the point of breakdown of the insulation 60,000 effective volts alternating is as bad as 85,000 volts direct, indeed may be worse than 100,000 volts direct. Further, with direct-current there is "no question about self-induction reducing the current—no objection, therefore, to putting the conductors as far apart as the risk of brush discharge may necessitate—no question about capacity current, no resonance troubles, etc." The author also states as another advantage of direct-current transmission as carried out by Thury that it is the current that is kept constant and the electric pressure that is automatically raised when the demand for power is increased. It is far more easy to maintain the constancy of the current flowing around a long circuit than to prevent the bobbing up and down of the electric pressure at the distant end of a long transmitting line and "that irritating dancing of the lights." "Constant current has also its well-known disadvantages, but these would not come into play if the constant current were not taken into houses, mines, etc., but used to drive motor-generators in sub-stations." The author then speaks of the development at Niagara Falls and argues whether similar developments of the electro-metallurgical nature are possible at the Victoria Falls in South Africa. "But jealously guard the beauty of your falls; Niagara was glorious nature, to-day it is power. Victoria is poetry."—Lond. *Elec.*, Sept. 22.

Size and Number of Units in Power Stations.—BUSHNELL.—An

article on the important influence which the choice of size and number of generating units may have upon the coal consumption of an electric power station. The main factor in the question is, of course, the fact that prime movers operate less efficiently (usually much less) at light loads than at full loads. That is to say, it is cheaper to run one engine fully loaded and have the other lie idle than to run both engines at half load. Another factor is that in electric railway power stations it is not regarded as practicable to change the speed of the air or circulating pumps, or to alter the quantity of cooling water to suit the varying loads upon the station, and these auxiliaries are usually operated at point sufficient to take care of the maximum load. Therefore the percentage of loss in the auxiliaries increases very rapidly as the load upon the main engine decreases. The two factors mentioned result in a distinct economy from such a number and proportion of generating units that, at all times of the day, the units in operation may be run at nearly full rated load. An illustration is given of two stations in which one would expect the fuel used per kw-hour to be practically the same, but on account of the different choice of units one station consumes 5 pounds of coal per kw-hour and the other only 3.8 pounds. —*Engineering News*, Sept. 28.

Electric Power Distribution in Italy.—An article on the power distribution by the Societe Lombarda in northern Italy. The main station is the hydraulic plant at Vizzola; it is five years old and has a capacity of 12,000 kw and supplies a net work of 120 miles. Most of the current is supplied to spinning and weaving mills. One year after opening of this plant the increasing demand for electrical energy necessitated the erection of another plant in Turbigo of a capacity of 3,500 kw. This plant was also provided with steam reserve having capacity of 5,400 hp. Another hydraulic plant utilizes 20,000 hp from the falls of the Poschiavino River; the capacity may be increased to 40,000 hp and the distributing network will cover about 90 miles. Some data are given on the cost of the installation and on the rates of charging. It is stated that the company paid last year 9 per cent dividends on the capital invested.—*Elek. Bahnen*, Sept. 4.

Controllers.—DUBOIS.—An article illustrated by diagrams on the construction of controllers for the operation of electric motors for various power purposes, and on the operation of the controllers by relays.—*L'Industrie Elec.*, Sept. 10.

Electricity in South African Mines.—WALSH.—A short article enumerating the various applications made of electricity in South African mines. These include the operation of deep-mine pumps and other mining machinery and lighting.—*Amer. Elec.*, October.

TRACTION.

Measuring the Resistance of Rail Joints.—SOULIER.—A description of an instrument of the Siemens & Halske Co., by which resistance of a rail joint can be directly compared with that of an equal length of rail. The apparatus is shown in Fig. 2. An insulating platform is placed on the rails with two contacts, *x* and *y*, at both

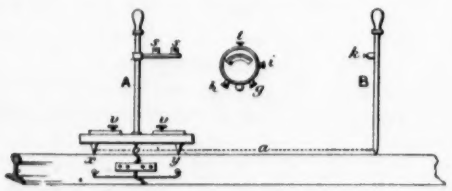


FIG. 2.—DIAGRAM OF APPARATUS.

sides of the joint. The differential voltmeter, *t*, is placed with the two terminals, *h g*, on the contact, *ss*, so that *h g*, are thereby electrically connected to the points, *x* and *y*, respectively. The conducting rod, *B*, is connected to a third terminal, *i*, of the voltmeter. The cane, *B*, is moved along the rail until there is no deflection of the needle of the differential voltmeter. That means that the same potential difference exists between points *x* and *y* as between *y* and *B;* in other words, the rail joint itself has a resistance equal to a length of rail *a* minus *b*.—*L'Industrie Elec.*, Sept. 10.

All-Steel Cars for Electric Railways.—A note stating that a demand has arisen in England for steel cars on electric railways. In some new cars for the Great Northern and City Railway Company, the only wood used will be that for the arm rests separating the seats. The use of steel for the body of the car makes it possible to combine great strength with light weight, as the whole lower portion of the sides is trussed so as to form a regular girder. As compared with wood, the saving in weight amounts to about 3 or 4 tons on a car weighing (in wood) 18 to 20 tons. This means, of course, a considerable reduction in operating expenses, and this is obtained without any reduction in the accommodation afforded, while the appearance is at least as good as if the car were of wood. The cost of the all-steel cars is about the same as one of fire-proofed timber.—Lond. *Eng'ing*, September 22.

Railroad Terminal Power Plant.—An illustrated description of the generating station of the New York Central & Hudson River Railroad at Weehawken, N. J. The plant has a total capacity of 2,000 rated boiler horse-power. Alternating current is used almost exclusively, 600-volt current being used for power and 2,300 volts for lighting. The power is chiefly used in a grain elevator which is equipped throughout for motor drive, the total capacity installed aggregating 3,300 horse-power. Three-phase, 25-cycle induction motors are used.—*Amer. Elec.*, October.

Alternating-Current Traction.—HERZOG.—Notes on trials on the Seebach-Wettingen road operated by alternating current at 15,000 volts. Three different methods of suspension are being experimented with. They are described in detail and illustrated.—*Elek. Bahnen*, Sept. 4.

Philippines.—FAUSER.—A long and profusely illustrated article on the building of an electric railway in the Philippines.—*Elec. Age*, Sept.

WIRES, WIRING AND CONDUITS.

Acetate Wire.—An illustrated article on the new acetate wire of the Allgemeine Elek. Ges., Berlin, which is greatly superior to silk-covered wires with respect to the space it occupies. The copper conductor is covered with a seamless layer of the excellent insulating material "cellulose-tetra-acetate." By means of special machinery numerous very fine layers are coated one above the other around the copper. The wire is said to be flexible, of high elasticity and great strength and to resist very strong mechanical stresses, although the insulating layer is only about 0.02 mm. thick. It is absolutely non-hygroscopic, is not affected by temperatures below 150 degrees, and layers of 0.02 mm. thickness are perforated in general not below 1,500 volts. The company makes acetate wires in all sizes from 0.07 to 0.17 mm. diameter of copper. The saving of space in comparison with silk-covered wires is given in the following table:

	Space factor in per cent.		
Thickness of wire.	Acetate wire.	Single silk-covered wire.	Double silk-covered wire.
0.07 mm	48	32	17
0.08	50	35	20
0.10	54	40	25
0.12	57	44	29
0.15	61	49	34
0.18	64	53	38
0.20	65	55	41

In this table "space factor" is the percentage of copper in a square surrounding the cross-section of the insulated wire.—*Zeit. f. Beleucht.*, Sept. 10.

ELECTROPHYSICS AND MAGNETISM.

Alpha Particles of Radium.—BRAGG AND KLEEMAN.—An account of an experimental investigation of the alpha particles of radium and their loss of range in passing through various atoms and molecules. The alpha particle moves always in a rectilinear course, spending its energy as it traverses atoms of matter, until its velocity becomes so small that it cannot ionize and there is in consequence no further evidence of its motion. Each alpha particle possesses, therefore, a definite range in a given medium, the length of which depends on the initial velocity of the particle and the nature of the medium. Moreover, the alpha particles of radium which is in radioactive equilibrium can be divided into four groups, each group being produced by one of the first four radioactive changes in which alpha particles are emitted. All the particles of any one group have the same range and the same initial velocity. The following are the values of ranges in air at a pressure of 76 cm. and a temperature of 20° C.:

Radium	3.50 cm.
Emanation of Radium A	4.25
Radium A or Emanation	4.83
Radium C	7.06

The results also show that the four groups are alike in all respects save that of initial speed; and further, that the alpha particle spends

its energy at a rate which is approximately inversely proportional to the square root of its speed. The loss of range of alpha particles in consequence of their passage through various substances is fo all the materials examined in traversing any atom nearly proportional to the square root of the weight of the atom. The loss in the case of a complex molecule is proportional to the sum of the square roots of the weights of the constituent atoms.—*Phil. Mag.*, Sept.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Durlach.—FREYSS.—Notes on the Durlach electric station which supplies current for power and lighting purposes to some railway stations and repair workshops in and near Karlsruhe. The station is owned by the state railways of Baden, and is presumably the largest of the numerous electric works which are attached to other railway stations of the system. It is stated that these railway stations altogether generated some 8,000,000 kw-hours during 1904, over 16,000 metric tons of coal being consumed for this purpose; that is, about 4½ lb. per kw-hour. The plant contains low-speed horizontal steam engines directly coupled to large dynamos. At present there are two three-phase generating sets each of 850 kw. The total capital expenditure was $325,000, of which nearly one-half was spent for the buildings, which are very elaborate and ornamental. The total capital expenditure for the plant installed is $191 per kw. Towards the end of last year the entire plant was officially tested. The chief results are: Steam consumption per kw-hour at full load (excluding excitation) 20.6 lb. weight of coal consumed per kw-hour generated (excluding excitation) 2.52 lb., mechanical efficiency of engine 92 per cent and efficiency of the alternator (excluding excitation) 96.7 per cent. The load factor was 28.2 per cent in 1904.—Lond. *Elec.*, Sept. 22.

Sub-Stations.—COLLISCHONN.—Long illustrated descriptions of some new sub-stations erected by the Felten and Guilleaume-Lahmeyer Works. The first sub-station described is in Breslau and transform three-phase current into direct current of 2 × 220 volts. The power given out in direct current is 1,000 kw. The set consists of a three-phase synchronous motor with a normal capacity of about 1,450 hp at 5,000 volts and 50 periods, coupled on each side with a direct-current dynamo giving 500 kw at 220 volts to 293 volts. The number of revolutions per minute is 187. The second sub-station described supplies the Hoechst chemical works in Gersthofen with direct-current for their electrochemical work. There are in use two motor-generators. Each consists of a three-phase synchronous motor of 1,650 hp at 5,000 volts, 50 periods and running at 107 revolutions per minute, and a direct-current dynamo giving 7,500 amperes at 112 to 150 volts.—*Elek. Zeit.*, Sept. 21.

Small Gas Engine Plant.—HOWARD.—A short article in which the author describes the isolated plant in a drug store in Worcester, Mass. A small gas engine drives a 17.5-kw generator supplying current at 110 volts. The outfit is situated in an obscure corner of the basement, together with a storage battery capable of discharging at the rate of 25 amperes on an eight-hour basis. Current is used for lighting both arc and incandescent lamps and for operating a small motor driving an ice crusher and an ice-cream freezer. Very little attention is required by the equipment beyond reasonably frequent inspection to see that everything is working properly. It is estimated that the cost of power per kilowatt-hour is 3 cents. —*Amer. Elec.*, October.

Isolated Plant Engineering.—HOBART.—An article containing much practical information concerning general engineering practice in a small plant. The article deals with steam plants, and treats of the economical production and utilization of steam.—*Amer. Elec.*, October.

ELECTROCHEMISTRY AND BATTERIES.

Aluminum Industry.—Statistics of the production of aluminum and bauxite in 1904. The production of aluminum in the United States has increased nearly tenfold in as many years. The production in the United States was 83 pounds in 1883, 61,281 pounds in 1890, 7,150,000 in 1900, and the consumption in 1904 was 8,600,000 pounds. The world's production in 1903 was 8,252 metric tons valued at $4,950,400 of which the United States produced 3,402 tons valued at $2,325,000. Aside from the electrical industry in which aluminum is gaining favor as a substitute for copper conductors for transmission lines, there has been expansion in other directions. The steel industry has become an important consumer of aluminum. The consumption of thermit shows marked expansion.—Publication of *U. S. Geological Survey.*

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electrostatic Voltmeter.—A description of an electrostatic voltmeter of Jona for measuring very high voltages. An instrument for 100,000 volts is shown in Fig. 3. The movable disc, *P*, is attracted

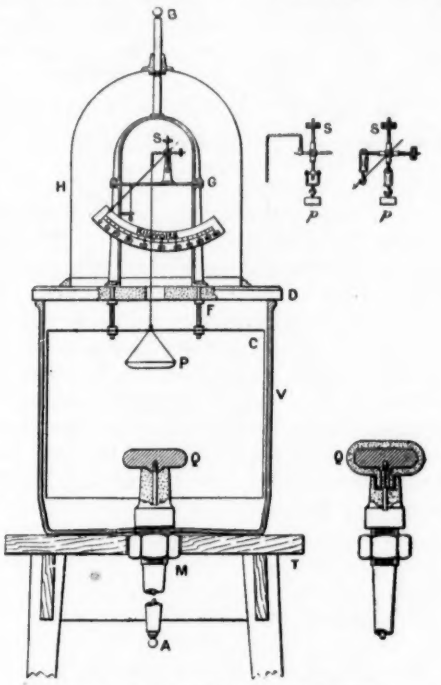


FIG. 3.—ELECTROSTATIC VOLTMETER.

by the stationary disc, *Q*, the two discs being connected respectively with the two poles of the apparatus, the voltage of which is to be measured. *P* is attracted and the degree of attraction is read on the dial directly in kilovolts. The stationary disc is mounted on a small column of ebonite passing through the bottom of the glass vessel, *V*, which is filled with paraffin oil. Concentrically with the walls of this vessel and electrically connected with the movable disc, *P*, is the metallic cylinder, *C*, which equalizes the potential in the interior of the apparatus. An instrument for 200,000 volts is also described.—*L'Industrie Elec.*, Sept. 10.

Leakage Indicator.—An illustrated description of some new in-

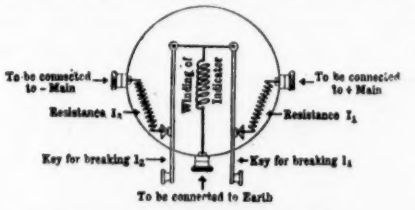

To be connected to - Main
Winding of Indicator
To be connected to + Main
Resistance I_2
Resistance I_1
Key for breaking I_2
Key for breaking I_1
To be connected to Earth

FIG. 4.—LEAKAGE INDICATOR.

struments made in England, especially a leakage indicator for two-wire direct-current installation in mines, as shown diagram-

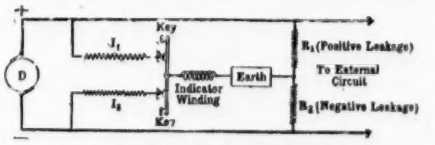


FIG. 5.—LEAKAGE INDICATOR.

matically in Figs. 4, 5, 6, which are self-explanatory. The pointer rests in the middle of the scale if the insulation of the two mains be

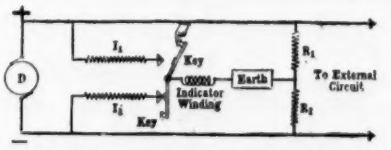


FIG. 6.—LEAKAGE INDICATOR.

sensibly equal (Fig. 5). If a ground develops on either, the pointer at once deflects and shows by the direction of its deflection

on which main the failure has occurred. This indication may be supplemented by a bell if required. To find the absolute value of the insulation of each main, the method indicated in Fig. 6 is used; it is, to depress first the + and then the —key and note the positive and negative deflections in degrees. From these two readings, the value of the insulation is found by the use of a table supplied with the instrument.—Lond. *Elec.*, Sept. 22.

Water Rheostat.—HADEN.—A short article on the construction of an efficient and easily made rheostat in which galvanized iron wire immersed in pure water is used. The rheostat is designed to absorb a load of 100 kilowatts for nine hours continuously with less than one per cent fluctuation.—*Amer. Elec.*, October.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Electric Clock.—An illustrated article on the "synchronome" electric clock. Each clock face has a one-wheel step-by-step dial movement behind it, operated by a switch combined with a pendulum in such a way that its switching function is automatically performed every half-minute. The actual switch consists of a weighted lever which falls in the act of driving the pendulum until it reaches the armature of an electro-magnet and makes the contact which causes the magnet to replace the weight and at the same time advances all the dials one tooth. The driving of the pendulum by the weighted lever has usually been accomplished by an ordinary clock escapement which imparts small impulses at every beat. Recently this arrangement has been improved upon as follows: In Fig. 7 *A* is the upper part of an ordinary seconds pendulum. *B* is a

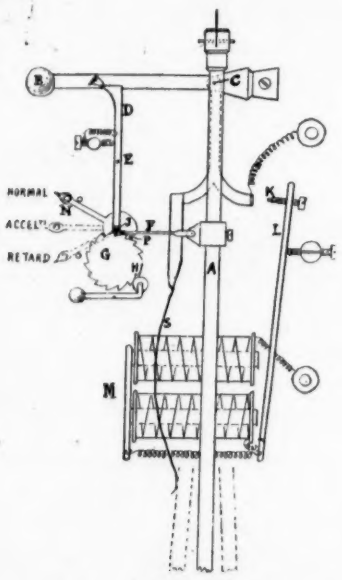


FIG. 7.—ELECTRIC CLOCK.

weighted lever or gravity arm centered at C. This lever is normally at rest, being supported by the vertical lever *D* centered at *E*. A pawl or driving click, *F*, pivoted on the pendulum is idly rotating the wheel, *G*, one tooth at each complete vibration of the pendulum. The wheel, *G*, has one of its teeth, *H*, cut shallow, and its object is to direct the pawl, *F*, once in every revolution, that is to say, once in every half minute, against the back, *J*, on the vertical lever, *D*, so that the support of the gravity arm, *B*, may then be withdrawn. This gravity arm then falls and bears with its whole weight upon the pendulum through the medium of the spring, *S*, traveling with it until the lower limb of the bell-crank lever comes into contact with the platinized screw, *K*, in the tail of the armature, *L*. The magnet, *M*, then resets the weighted lever, and the dial magnets in circuit with it are actuated as in the usual "synchronome" switch. The advantages of the new arrangement are pointed out.—Lond. *Elec. Times*, Sept. 21.

Microphone.—Experiments have recently been made with long-distance telephony from Rome, Italy, to London with alleged good results. A new microphone, devised by Majorana, has been used in these tests. "According to the statements of the inventor, it is based on the contraction of a capillary column of liquid under the influence of sound waves. The contractions produce changes of resistance in an electric circuit in such a way that waves of 500 periods per second produce, under favorable conditions, telephone currents of 100 milliamperes. The best microphones in use at present in Italy give telephone currents of 20 to 25 milliamperes. The sounds received should, therefore, be very strong with the Majorana microphone. Moreover, it is stated that they fulfill all wants with respect to clearness of speech."—*Elek. Zeit.*, September 7; from *L'Ettricista*, July 1.

Printing Telegraphic Apparatus.—GUARINI.—An illustrated description of the Siemens & Halske printing telegraphic apparatus. A perforated band is first prepared by means of a special apparatus termed a perforator and operated like a typewriter. This band is introduced into the automatic transmitter, where the holes in the paper cause alternately positive and negative discharges into the line. In the receiver a strip of photographic paper is unwound in a dark chamber in front of a type wheel, upon the periphery of which the letters of the alphabet are perforated. This wheel moves synchronously with the transmitter; at the moment when the letter transmitted passes in front of the sensitive strip, an electric discharge takes place between the spheres of an oscillator, and the letter is photographed. As the type-wheel revolves at the rate of 2,000 r.p.m., and as a letter can be printed at each revolution, the maximum speed of transmission can be calculated at 120,000 letters per hour, or about 20,000 words. Fig. 8 shows the type wheel revolv-

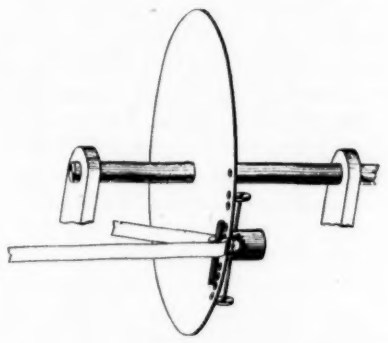


FIG. 8.—PRINTING TELEGRAPH APPARATUS.

ing between the spark-gap and the photographic tape. The different parts of the apparatus are described in detail.—Lond. *Elec. Rev.*, Sept. 22.

MISCELLANEOUS.

Construction of a Jump Spark Coil.—An illustrated article on the construction of a jump spark coil for gas engine ignition purposes. Sufficient data are given to enable any fairly competent amateur to build the coil.—*Amer. Elec.*, October.

Aluminothermics.—A report by a Franklin Institute Committee on Goldschmidt's method of aluminothermics with applications to welding and repairing.—*Jour. Franklin Inst.*, September.

Manufacturing Plant.—Fully illustrated descriptions of the new plant of the B. F. Sturtevant Company at Hyde Park, Mass.—*Iron Age.*, Sept. 28, *Amer .Mach.*, Sept. 28.

Electric Welding.—A report by a Franklin Institute Committee on the Cleveland Cap Screw Co.'s cap screw and bolts with a description of the method of electric welding used.—*Jour. Franklin Inst.*, September.

Shop System for Electrical Contractors.—AUERBACHER.—A description of a shop and accounting system suitable for concerns doing a general electrical contracting and jobbing business. Various forms are given, which have been designed to avoid the cumbersome details in many record forms. The method of keeping these and their significance are dealt with at length.—*Amer. Elec.*, October.

Diamonds.—CROOKES.—A paper presented before the British Association of Advanced Science, at Kimberley, South Africa. Carbon volatilizes at the ordinary pressure at a temperature of about 3,600° C. and passes from the solid to the gaseous state without liquefying. To liquefy it high pressure must be added to high temperature. On cooling it will then crystallize and artificial diamonds are obtained. Two methods of making small artificial diamonds are described. The first one depends on the solution of iron in carbon, the second employs closed-cylinder explosions.—Lond. *Elec.*, September 8.

BOOK REVIEWS.

TRANSACTIONS OF THE INTERNATIONAL ELECTRICAL CONGRESS OF ST. LOUIS, 1904. Three volumes. 2,844 pages, 698 illustrations in the text, 124 inserted half-tone sheets and three photogravure frontispieces. Price, in paper covers, $10.

These three portly tomes should do much toward giving a new lease of life to the idea of International Electrical Congresses held in conjunction with world's fairs. The earlier congresses derived their importance largely from being scientific legislative bodies, and with the decay of this function it seemed that the *raison d'etre* of such international meetings would pass away. While at St. Louis a Chamber of Delegates, appointed by governments, formed part of the congress, it was well understood at the outstart that the proceedings of this section would not have a high importance, and in fact its only action was to formulate recommendations, the adoption of which will make it the last of its line. These recommendations, which will undoubtedly be given effect, provide for the transfer to two international commissions—one appointed by governments and another by national professional bodies—of the work heretofore taken cognizance of by the officially-appointed section of an international electrical congress; and there is little probability that the meetings of the former, or, even of the latter, will be held amid the distractions of a world's fair.

The great success of the St. Louis Congress was thus due to its purely professional programme—the reading and discussion of scientific and engineering papers. As printed in these volumes, the proceedings form perhaps the most important single contribution ever made to technical literature, whether judged with respect to average intrinsic merit, or collectively as an epitome of the state of electrical scientific and engineering knowledge in the year 1904. It is particularly in this latter character that international electrical congresses deserve continuation, for no one can question the value of taking systematic account at intervals of the current state of knowledge in the rapidly developing departments of electrical science and engineering; and the experience of the St. Louis Congress has demonstrated that authoritative writers the world over will gladly respond to an appeal for collaboration based on these grounds. As a first attempt in this direction the St. Louis proceedings naturally fall short of the ideal of such a *comptes rendus*, several of the papers being quite perfunctory in character, and a few others scarcely more than "write-ups" of ephemeral or even no value. Future congresses can, however, easily remedy these defects, one obvious means being to confine the selection of subjects and authors and the final acceptance or rejection of papers submitted in response to invitations, to a small and carefully selected commission, instead, as appears to have been done in the case of the St. Louis Congress, of so loosely distributing this function that there was no positive check on the inclusion of unfit papers.

The total number of papers contained in the *Transactions* is 159, the following nationalities being represented: United States, Canada, Mexico, Great Britain, Italy, Sweden, Germany, Japan, Australia, France, Belgium, Denmark, Switzerland, Hungary and Austria. In the discussions there are represented, in addition, India, Argentine Republic, Spain and Holland. The *Transactions* also contain an account in detail of the organization of the congress, the proceedings of the opening and closing general meetings and the proceedings of the Chamber of Delegates.

Of the eight sections of the congress undoubtedly the proceedings of Section A—General Theory, Mathematical and Experimental—are of the highest permanent value. Twenty-seven papers were presented in this section, with scarcely an exception of an exceedingly high order of merit. The subject of radioactivity was treated in papers by Elster and Geitel, Rutherford, J. J. Thomson and McLennan. Electrical units and electrical standards are the subjects of papers by Carhart and Patterson, Ascoli, Giorgi, Wolff and Jaeger. Other subjects are the theory of ionization by collision, by Townsend; alternating-current theory of transmission speed over submarine cables, by Kennelly; the mechanical equivalent of heat as measured by electrical means, by Barnes; electric arc, by Child; the absolute measurement of inductance, by Rosa and Grover; the coherer (which would seem to belong to the telephone section), by Guthe; recent advances in the analysis of the earth's permanent magnetic field, by Bauer; Lorentz's theory of electricity, by Webster; electric conduction in metals from the standpoint of the electronic theory, by Drude; magnetostriction, by Nagaoka; secondary standards of light, Violle; condensation nuclei, by Wilson; electrical conductivity of gases, by Lewis; electrostriction, by More; wave lengths between the longest thermal and shortest electric waves, by E. F. Nichols. Dr. Pender contributed a most interesting paper giving an account of his work in confirming the accuracy of Rowland's great experiment on the magnetic effect of moving charges, and Dr. Arrhenius, in a remarkable paper, treated of the electric charge of the sun. The discussions in this section are of a value and interest commensurate with the importance of the subjects considered, many of those taking part being men of international scientific authority. In particular the discussions on units and standards is of timely interest and importance.

In Section B—General Applications—twenty papers were presented, the authors being Steinmetz, Behrend, S. P. Thompson, Ryan, Blondel, Eichberg, Mordey and Hansard, Jouaust, Sharp, Nodon, Rosa, Lloyd and Reid, Day, Boucherot, C. A. Adams, Rushmore, Arnold and la Cour, Heyland and Hobart. Among the subjects treated are eddys and hysteresis in iron, magnetic viscosity, electrolytic rectifiers, testing of alternating-current generators, plunger electromagnets, high-pressure insulation, single-phase railway motors (which seems misplaced in this section), armature reactions, alternators in parallel, induction motors, regulation of alternators, compound alternators with alternating-current excitation and the commutation of direct and alternating currents. The principal discussions were on eddys and hysteresis in iron, testing of alternating-current generators, influence of wave form on the rate of integrating induction meters, the design of high-pressure insulation, armature reaction, the leakage reactions of induction motors and the regulation of alternators. The paper by Prof. E. Arnold and J. L. la Cour, forms an exhaustive treatise on the subject of the commutation of direct and alternating currents, the text and illustration taking up almost 70 pages of the *Transactions*.

In Section C—Electrochemistry—fifteen papers were presented, the authors being Ostwald, Lorenz, J. W. Richards, Kennelly and Whiting, Heroult, Hulett and Carhart, Guthe, Goldschmidt, Betts and Kern, Kahlenberg, Haber and Bruner, W. D. Bancroft, Edstrom and T. W. Richards. Among the more practical subjects treated are the electrical extraction of nitrogen from the air; the chemistry of electroplating; chlorine in metallurgy; alumino-thermics; electrometallurgy of iron and steel and the Edison storage battery. Other subjects are the carbon cell, the silver voltameter, the lead voltameter, standard e.m.f. cells, electrolysis of fused salts, electrolysis and catalysis, electrolytic conduction, the electrochemical series of the metals, and the hypothesis of compressible atoms. Almost every paper presented in this section was the subject of discussion, the most lively being that on electrolytic conduction.

Section D—Electrical Transmission of Power—comprises sixteen papers. Those of Perrine, Gerry, Kelly and Bunker, Nunn, Hancock, Hayward and Baum treat more particularly of the design and operations of the far western transmission plants. A paper by Scott deals with electrical power transmission in a general way, and Mershon in a mathematical paper sets forth formulas for determining the maximum distance to which electric power can be economically transmitted. Papers on details of electric power transmission were presented as follows: High-tension transformer, by Peck; aluminum as an electrical conductor, by Buck; conductors for long spans, by Blackwell; high-tension insulators, by Converse. The remaining papers are on experiments with transformers of very high voltages, by Prof. H. P. Smith; sparking distances, by Fisher, and a curious contribution entitled "Electrical Transmission Plants in Switzerland," which in fact treats of Swiss central stations, scarcely touching upon power transmission in the usual acceptance of that term. Moreover, the paper merely gives a crude synopsis of a table of data compiled and printed by the Association of Swiss Central Stations. The discussions in this section, which are both more voluminous and more discursive than those of any other section of the Congress, are principally confined to various aspects of high-tension transmission in California and the Rocky Mountain region.

The lengthiest section of the *Transactions* is that occupied by Section E—Electric Light and Power. Twenty-five papers were presented before this section, the authors being Arthur Wright, F. De Foder, G. N. Eastman, W. C. L. Eglin, Carl Roderbourg, E. Jona, Philip Torchio, Alex Dow, Gotthold Stern, L. A. Ferguson, Prof. Clarence Feldmann and Joseph Herzog, Dr. C. P. Steinmetz, Prof. Andre Blondel, Col. R. E. B. Crompton, Prof. Lombardi and G. Mellazo, Prof. E. L. Nichols, Gerhard Goettling,

Henry Noel Potter, W. L. R. Emmet, Prof. A. Rateau, F. Hodgkinson, C. D. Haskins, G. Ross Green, V. Poulsen and H. F. Parshall. Subjects represented by two or more papers are the steam turbine, three papers; direct vs. alternating-currents for central station distribution, four papers; meters and meter rates, four papers; distributing systems, three papers; luminous electric arcs, two papers. The subjects of other papers are the Prussian system of train lighting; insulating materials for high tension cables; standardization of electrical apparatus; stroboscopic observations of the arc; standards of light; storage batteries; the Nernst lamp; a system for producing continuous electrical oscillations, and a description of the Yorkshire & Lancashire Electric Power Companies.

The principal discussions were on rates for electrical supply; direct current vs. alternating-current distribution from central stations; luminous electric arcs; standardization of electrical apparatus and the steam turbine. Three of the four papers on central station systems championed the direct-current side, and in the discussion the advocates of direct-current were present in great majority. Consequently, if one were to judge by the space occupied by its partisans and by their aggressiveness, the direct-current presentation carried the day. This might indeed be considered the last grand rally for the direct current, for one is not rash in predicting that when electric supply distribution comes up before another congress for discussion, there will be only one side to the question—and that will not be the direct-current side. The contributions by Profs. Steinmetz and Blondel on luminous electric arcs are of the highest value, every phase of the subject being ably treated by these distinguished writers.

The paper by Col. Crompton on the standardization of electrical apparatus gave the results of the deliberations of the English Electrical Standardization Committee. The discussion developed a wide difference between British and American opinion on the subject of standardization, and it would appear to be wise for the British Standardization Committee to delay final action on their work until the whole subject has been considered by the international standardization commission recommended by the Chamber of Delegates. Owing to the lamentably backward condition of electrical engineering in Great Britain, that country can scarcely hope to impose her decisions as to standardization on countries like the United States, Germany, Italy, Austria-Hungary, Switzerland and France—all far in advance of her in electrical engineering design and practice; consequently any rules formulated in conflict with the practice of these countries will, while complicating the international standardization situation, at the same time tend still further to minimize Great Britain as a factor in the electrical industry outside her territorial bounds.

Among the papers of more permanent value presented in this section are those of Eastman on protection and control of large high-tension alternating-current systems; Jona on insulating materials of high-tension cables; Feldmann and Herzog on the distribution of voltage and current in closed conducting networks; the papers of Blondel and Steinmetz on the luminous arc; Nichols on standards of light; Lombardi and Melazzo on stroboscopic observations on the arc; Green on wattmeters, this forming an excellent contribution to the central station side of the subject; and the admirable paper of Parshall on the district supply of electrical energy, which treats a question that is rapidly assuming high importance in this country. The omission of a half dozen perfunctory and "write-up" papers from this section would have strengthened it.

Section F—Electric Transportation—includes 16 papers, exactly one-half of which relate directly to single-phase traction systems and apparatus, the authors being B. J. Arnold, Steinmetz, Deri, Latour, Bragstadt, Danielson, Lincoln and Niethammer. To this list should also belong the paper by Eichberg, printed in another section. All of these papers were discussed together, the discussion occupying 19 pages of the *Transactions*. This budget of papers and their discussion form the most complete presentation in print of the several forms of single-phase street railway systems and motors. The only other discussion of importance in this section was that on the presidential address delivered by Mr. B. J. Arnold at a joint meeting of the Congress, and the American Institute of Electrical Engineers, the subject being the electrification of steam railroads. This discussion occupies 20 pages, and together with that above mentioned forms a most interesting and complete contribution to the modern electric railway problem. Another paper of great permanent value is that of Mr. Frank J. Sprague on the history and development of the electric railway. This paper traces all of the important steps in the development of the electric railway, beginning with the experiment of Davenport in 1834, dates and all important details being given. A concluding paragraph also discusses the trunk line electrification problem. Still another discussion of heavy electric traction is given in a paper by Mr. Philip Dawson, the subject being the electrification of the British railways. The conclusion of Mr. Dawson is that there is no country in the world in which electrification would be a greater benefit to the railways than the United Kingdom, and that when once a movement in this direction begins the rate of transformation will be rapid. Other papers contributed to this section are as follows: The storage battery in electric railway service, by J. B. Entz; the Monorail railway, by E. B. Behr; the booster in railway service, by Prof. Dr. Rasch; breaking high speed trains, by R. A. Parke.

Section G—Electric Communication—included 20 papers. By far the most interesting of these are four papers on wireless telegraphy, the authors being the Marquis Solari, John Stone Stone, Dr. Lee De Forest and Dr. J. A. Fleming. The discussion on these papers, unfortunately, was not very extended, the only point treated being the theory of the so-called electrolytic receiver. A paper on high-frequency telephone circuit tests by Dr. Kennelly, and another on loaded telegraph lines in practice, by Dr. H. B. Hayes form valuable contributions to the more technical side of telephony. Mr. J. Hesketh in a paper gave an account of the ravages in Australia of an insect which attacks the lead covering of telephone cable; it appears from the discussion that trouble from the same source has been experienced in China, and even in the Southern states of this country. Rapid telegraphy was treated in five papers, their respective authors being Mr. J. C. Barclay, Mr. P. B. Delany, Mr. F. W. Jones, Dr. L. M. Potts and Prof. Ferdinando Lori. Other papers are on telegraphy and telephony in Japan by Mr. Saitaro Oi; simultaneous telegraphy and telephony, by Herr Joseph Hollos; military use of the telegraph, telephone and cable, by Colonel Samuel Reber, U. S. A.; automatic vs. manual telephone exchanges, by K. B. Miller, which paper was followed by a discussion of some length; the theory of telephone exchange development, by M. de la Touanne; economical features in modern telephone engineering, by Mr. L. W. Stanton; features of the Dunbar two-strand common battery systems, by Prof. J. C. Kelsey. Prof. G. F. Sever contributed a valuable collection of data relating to the electrolysis of underground cables. These are comprised in five tables, in which are digested opinions regarding electrolysis of underground conductors and its remedy, collected from railway and municipal reports and numerous other sources of information on the subject. The discussion of this paper brought out some further points of interest.

The final pages of the *Transactions* contain the proceedings of Section H—Electrotherapeutics—the roll of members and list of subscribers to the *Transactions*. Twenty papers were presented in Section H, the only one of interest to electrical people being a report by Dr. Samuel Sheldon, Mr. W. J. Jenks and Mr. C. L. Clarke on current classification and nomenclature, and on tests of electrostatic machines. All the other papers are on medical subjects. In most cases they reveal scarcely a speaking acquaintance with electrical science, properly speaking, though dealing largely in electrical terms. In the opinion of the reviewer, a blunder was committed when the branch of electrotherapeutics was given representation as a section of an electrical congress, the empirical methods of this branch of medicine—if, indeed, it may be considered a recognized branch of medical science—having nothing in common with the methods of physical science.

The Automobile Pocketbook. By E. W. Roberts, M.E. Cincinnati: Gas Engine Publishing Company. 329 pages, 51 illustrations.

This convenient book for the pocket should be found useful by automobilists who wish to learn the principles of gas engine vehicles and obtain hints as to their care and operation. The preface states that in the preparation of the matter the author applied to manufacturers of automobile engines for information and consulted the instruction books issued by the various automobile manufacturers. Matters of design are wisely not entered into, and in the thirty-six

chapters of the book is scattered practical information relating to the care and manipulation of every detail entering into a gas engine automobile.

Methods of Charging for Current-Supply to Incandescent Lamps.

IN judging the various methods used or proposed for charging for current it is necessary to form first a clear idea of the conditions which should be fulfilled by a perfect method. These conditions are as follows:

1. The charges for current to different consumers should be approximately proportional to the cost of supplying them, unless it can be conclusively shown that another ratio of charges secures greater profits. In most mercantile transactions the cost of production ultimately governs prices; there is, therefore, a strong presumption in fixing the price of any commodity in favor of being governed by its cost of production.

2. The method of ascertaining the amount of the charge should be reasonably accurate, simple and consequently cheap; it should consume little or no power and should not interfere with good voltage regulation.

3. In charging for current to small and poor consumers it is desirable to know beforehand the cost of supplying the current and the consequent charge, so that it can be collected in advance without giving credit.

In ascertaining the degree of perfection of any method it is, therefore, necessary to consider first what determines the cost of production of the current supply. Here it is of some importance to distinguish between a water power plant and a steam plant.

In a water power plant using no storage, either of water or by means of storage batteries, the cost of current supply is governed by the peak load and is practically independent of the number of kilowatt-hours furnished. A charge based on the peak load caused by each consumer is, therefore, in proportion to cost of production. Such a charge will alone perfectly comply with the first condition mentioned.

Where storage batteries are used it would, on superficial consideration, appear that this is not the case, since the current not used during times of small load can be used for charging the batteries, and these can furnish part of the peak load. This current would otherwise go to waste, or would not be produced, without material reduction of cost. It may, therefore, be assumed to cost practically nothing. The part of the peak load supplied by the batteries may then be cheaper than that supplied directly. If the method of charging according to peak load would cause an almost continuous peak so as to make the charging of batteries impossible, then charging according to peak load would not be in proportion to cost of production. This is, however, never the case; it is, therefore, strictly true, whether storage batteries are used or not, that the cost of production of the current supply for different consumers is, in a water power plant, in proportion to the peak loads caused by them. Where this method of charging does not greatly increase the number of kilowatt-hours used with a given peak load, the kilowatt-hours will generally have no material influence on the cost of current supply even in a plant where water storage is extensively used. And the above holds, therefore, also in this case.

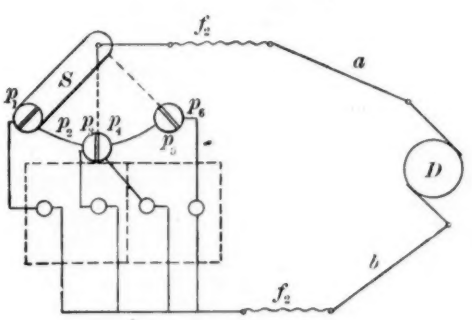
In steam plants it is evident that the coal consumption is nearly proportional to the number of kilowatt-hours used. With 4 pounds of coal used per kilowatt-hour at the lamps and coal at $3.50 a net ton in the bunkers, the cost of coal per kilowatt-hour is 0.7 cent. If all costs, inclusive of interest and profit on capital, amount to 7 cents per kw-hour at the lamps, the coal causes 10 per cent of the total cost.

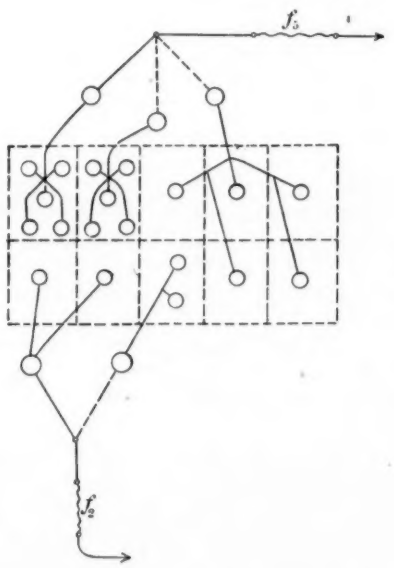
Small changes in the number of kilowatt-hours corresponding to a given peak load will hardly affect the cost of the boiler room force. All other costs in a steam plant are practically proportional to the peak load. With a given peak load an increase of 50 per cent in the number of kilowatt-hours used will cause an increase of only about 5 per cent in the cost of the current supply.

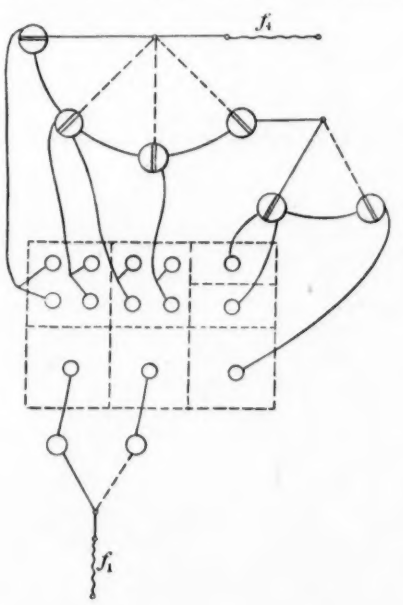
Generally more than 0.9 of the cost of current supply is proportional to the peak load and less than 0.1 is proportional to the number of kilowatt-hours used. A perfect method of charging would be governed by this proportion. We are now prepared to judge the degree of perfection of the existing and some proposed methods of charging for current supply to electric lights.

There are two fundamentally different methods of charging and various compromises between them in use. The first of these is based on the number of lamps installed and the second on the number of kilowatt-hours of current used. In the first the peak load which may possibly be caused by the consumer, but not that which he will actually cause, governs the charge. A concrete case is best adapted to show the great difference between the two. Take a tenant of a five-room flat who has three lamps in the drawing-room, three in the dining-room, two in one of the bedrooms and one each in another bedroom, the bathroom and a kitchen, in all 11 lamps. He may possibly light these 11 lamps at the same time and thereby cause a corresponding peak load. If he is of an economical disposition he could easily get along without using more than four lamps at one time. He may use three in either the drawing or dining-room and one in the kitchen, or he may use two in one bedroom and one each in another bedroom and bathroom.

A flat rate based on the number of lamps installed is, therefore, far from identical with a rate based on the actual peak load caused by the consumer. Consequently, it does not comply with the first of the three conditions of a perfect system of charging. Where it is in force the consumer has little inducement not to light occasionally all his lamps at the same time and thereby to produce a peak load equal to the current needed for all the lamps installed. It is, however, a simple and cheap method of charging; it consumes no power and does not interfere with the voltage regulation; it permits the fixing and collecting of the charge in advance, but does not allow







FIGS. 1, 2 AND 3.---DIAGRAMS OF DISTRIBUTION OF LIGHTS.

an accurate estimate of the cost of current supply. It causes large peak loads and is mainly for this reason very uneconomical. The method has, therefore, been largely supplanted by some one of those based on the use of meters.

Meters generally measure the number of kilowatt-hours used; they do not measure the peak load caused by the consumer. This latter is, however, the most important of the factors governing the cost of current supply. In making out the bills an attempt is made to correct this deficiency of meters by either estimating or measuring by a special meter the amount of the peak load and then basing the bill partly on the peak load and partly on the number of kilowatt-hours used. The estimate of the peak load has the defect that it assumes it to be a given fraction of the number of lights installed, and thereby removes the inducement for economy in regard to peak load, which does exist where the peak load is measured. The consumer with an estimated peak load has no special reason not to use during the hours of plant peak load all his lights at the same time, and cannot be supplied as cheaply as a consumer with a measured peak load. Watt-hour meters do, therefore, not comply with the first condition, which requires charges in proportion to cost of production. They are, moreover, most defective as regards the second and third conditions, which must be fulfilled by a perfect method of charging.

They are complicated and consequently expensive contrivances; they are costly to maintain in good order; they soon begin to run slow and must be repaired; they must be read monthly and it is practically necessary to make out monthly bills. They consume power and cause loss to the company by going slow. They cause a variable loss of voltage and thereby interfere with good regulation. The cost of supplying the consumer cannot be foreseen nor can his charges be fixed beforehand. These objections become especially serious where small consumers using only a few lamps at the same time are to be supplied. For these small consumers there is, however, a new method available which almost completely complies with all the conditions of a perfect method of charging. It consists in the use of a combination of switches and fuses for limiting and measuring the amount of current supplied to the consumer. It can be most easily explained by means of concrete examples.

In Fig. 1, s represents a switch arm of a three-point switch. Each point, $p_1 p_2$, $p_3 p_4$, $p_5 p_6$, consists of two insulated parts, which are covered and connected to the current supply at one position of the switch. The part p_2 of the first point is electrically connected with p_3 of the second point, and p_4 is connected with p_5. The points are connected as shown with lamps indicated by circles in the rooms, the walls of which are marked by dotted lines; f_2 represents fuses adjusted to the current required by two lamps; a and b are the mains leading to the source of current. The switch shown permits the lighting of two lamps at one time, either both in one of the two rooms or one lamp in each room.

Fig. 2 shows a total of 19 lamps in 10 rooms, 7 of which can be lighted at the same time. One three-point and one two-point switch are required and permit the simultaneous lighting of various groups of 7 lamps. The fuses are intended to be closely adjusted to the number of lights supplied through them. They will thereby give an additional guarantee to the company that no largely excessive amount of current is used. This latter could, however, be done by connecting around the switches or otherwise interfering with them.

Fig. 3 shows 13 lamps in 7 rooms, 5 of which lamps may be lighted at the same time. One of the switches has four split points, another supplied from this two split points, and a third independent switch two solid points. These switches permit 10 different combinations of 5 lamps to be lighted at one time. The last two examples shown are about the most complicated for which various combinations of the contrivances shown are adapted. The consumer may desire on special occasions to light all his lights at one time. To make this possible a special locked switch connecting all the lamps to the supply must be installed. The key to this switch would have to be kept by the company, which will, upon notice received, make the connection at any time except when the load reaches the capacity of the plant. This causes little expense to the company and can be done for a small charge. The charge for current would be based on the number of lamps used at one time or on the peak load which the consumer causes. If he pays in addition for the lamps he uses he has sufficient inducement to turn them out when not wanted. By this method the peak load alone is considered in charging, but it is the actual peak load and not an arbitrarily estimated one. It is, therefore, to the interest of the consumer to make the peak load as small as possible and thereby to decrease the cost of his current supply. This result is not secured by either a flat rate or the use of watt-hour meters. The consumer will hardly neglect to turn out his lights when he goes to bed since not to do this would materially increase the cost of his lamps.

The bulk of the small consumers have practically the same habits and will use nearly the same number of kilowatt-hours for a given number of lamps used at one time. Charges based on this number of lamps are, therefore, very nearly in proportion to the cost of supply. The method here proposed agrees more perfectly than any of the existing methods—with the possible exception of one based on the use of two meters—with the principle of charging according to cost of production. No meter is required on the consumer's premises, the switches use no current and cause no reduction of voltage; they are cheap to buy and maintain.

The yearly cost of a meter allowing 10 per cent of cost of meter installed, for interest, taxes and profit on investment, the cost of maintaining it in good condition, of reading it and making out and collecting monthly bills, the cost of the power it consumes and the losses it causes to the company by its inaccuracy—these amount in all for a small dwelling using four lamps at one time to about $5.

The yearly cost of the switches which replace the meter and simpler switches that would otherwise be used, is, together with the royalty and the cost of making out and collecting yearly or half-yearly bills, probably not in excess of 60 cents per dwelling.

The saving in small dwellings is, therefore, considerable, and will, in many places, make it possible to furnish electric light cheaper than gas. This will enormously increase the demand per square mile and will thereby greatly reduce the cost of current distribution, causing another saving varying much in amount with circumstances and often of more importance than that above mentioned.

For large dwellings using many lights the costs inseparably connected with the use of meters are not such a heavy burden and the contrivances described are not suitable for them since they would limit the freedom of the presumably wealthy occupant to an extent which he would not submit to. In small dwellings a nearly absolute freedom in the choice of lights to be used at the same time becomes possible without much complication in the switches.

The advantage due to the greater demand per square mile and the consequently reduced cost of distribution will extend to all consumers, whether they use meters or not. The contrivances described will, therefore, not replace meters; they will rather be a means of extending the use of electric lights to districts, which could previously not be profitably supplied an account of the excessive cost of meters for small dwellings. Most of the new districts supplied will contain a number of large dwellings; the use of meters may, therefore, even be increased by supplying a cheap substitute for them in places for which they are not well suited.

The above-described method has been devised by Joseph Mayer, C.E., 1 Broadway, New York, who has applied for patents on its details.

Single-Phase Railway for Spokane.

A contract has just been closed with the Spokane & Inland Railway Co. by the Westinghouse Electric & Manufacturing Co., of Pittsburg, Pa., for the equipment of an electric road, the present terminals of which will be Spokane, Wash., and Moscow, Idaho, 146 miles apart. The roadway is completed from Spokane to Waverly, a distance of 34 miles, and operation will be begun on this as soon as possible. The road is a home enterprise, the stock being held entirely by men living in the district through which the line passes—business men, professional men and farmers. The directors of the company are J. P. Graves, president; F. A. Blackwell, vice-president; F. Lewis Clark, John Twohy and Alfred Coolidge, all men of wealth who have been so long identified with enterprises of magnitude that their names insure the success of any undertaking with which they associate them.

In selecting the equipment for this road, both the direct-current and the single-phase systems were considered, but, after careful comparison the single-phase alternating-current system was adopted. Not only did the estimates show a large saving in initial investments and in annual operating expenses in favor of the single-phase system, but a form of heavy traction is made possible

which would be practically unfeasible with the direct-current equipment. Besides the passenger traffic the company is preparing to do a heavy freight business and also to carry mail and express.

Power for the operation of the road will be purchased from the Washington Water Power Co., which will supply three-phase currents at 4,000 volts, 60 cycles, to a frequency changing station approximately 1½ miles from the generating station. Seven 750-kw, oil-insulated, water-cooled transformers will step down the voltage from 4,000 to 2,000 volts, the potential for which the induction motors of the frequency changing sets are wound. There will be four of these motor-generators or frequency changers of 1,000-kw, capacity each at normal rating. Each consists of a 1,000-hp, three-phase, 2,000-volt, 60-cycle induction motor, a 1,000-kw, single-phase, 2,200-volt, 25-cycle revolving-field alternator, and a 750-hp, 550-volt, direct-current generator which is to float on the storage battery acting alternately as a motor and generator. The three machines will be mounted on a single bed plate with seven bearings. Exciting current for the alternators will be supplied by three sets, each consisting of a 750-hp, three-phase, 2,000-volt induction motor and a 50-kw, direct-current generator.

Nine 675-kw, oil-insulated, water-cooled transformers will step-up the voltage from 2,200 to 45,000 volts, at which pressure it will be transmitted to the fifteen transformer sub-stations, each containing two 375-kw, 45,000-6,600-volt, oil-insulated, self-cooling transformers. A twenty-three panel switchboard, electrically operated automatic oil circuit-breakers, and protective apparatus, complete the equipment of the frequency changing station. Low-equivalent lightning arresters and choke coils are provided for both primary and secondary circuits in all sub-stations.

The transmission lines will consist of two No. 2 copper wires, and the trolley will be of the standard catenary construction, using a No. 3-0 wire and carrying current at 6,600 volts.

Each passenger car will be equipped with four 100-hp motors, capable of maintaining a schedule speed of 35 to 40 miles an hour. In the freight service four 150-hp motors will be used on each car. For the heavy freight service double locomotives weighing approximately 70 to 80 tons will be used, each consisting of two parts and each part a complete 35 to 40-ton locomotive. Two or more of these locomotives may be coupled together and operated from the front cab as a single unit. The motor cars and locomotives will all be operated by the Westinghouse multiple-unit control system. The motors will operate under three different conditions, 6,600 volts alternating-current in the interurban districts, 700 volts alternating-current in the smaller towns, and 575 volts direct-current in the city of Spokane.

Electrically-Driven Pumps.

The accompanying illustrations show the latest designs of the Allgemeine Elektricitäts-Gesellschaft for electrically-driven pumps. The outfits have been designed with especial reference to the best running conditions of high-speed electric motors. A most noticeable feature is the very compact arrangement of the pump and the motor.

The single-acting principle has been adopted throughout and for smaller outputs only one plunger is used (Fig. 1). In larger sizes, however, where the necessity for dealing with greater quantities of water requires it, the double plungers are employed, as shown in Fig. 2. All parts are designed specially for the requirements of high-speed pumps, and a short stroke is chosen to keep the plunger within the required limits, namely, 3 to 4 ft. per second.

The water, entering through the suction pipe (Fig. 3) is first retained in the suction chamber situated before the suction valves, *A*, which are arranged as group valves round the plunger. The delivery valves, *B*, are likewise grouped, concentrically and directly opposite to the suction valves. To render the flow of water uniform from the delivery outlet, which is arranged on the side of the pump, an ample delivery air vessel, *F*, is provided. The valves open and shut automatically, and in order to make certain of proper working at the high speeds of the pump, they are specially designed for the purpose, with as little weight as possible, small lift and large valve area, so that all pounding or failure in action is precluded.

The valve seatings and rings are of metal, to prevent leakage; the seatings are provided with leather rings, but for pumping warm water metal seatings are alone employed. The springs are of hard-drawn brass, and keep the valves firmly up against the seatings. The delivery valves are at once accessible on removing the cover, *E*, and the suction valves likewise, on removal of the cover, *D*, which is held in place by the cover, *E*.

An air compressor is supplied to furnish the necessary compressed air to the delivery air vessel, and is driven from the cross-head pin directly or in the larger types, by a pin from the end of the pump

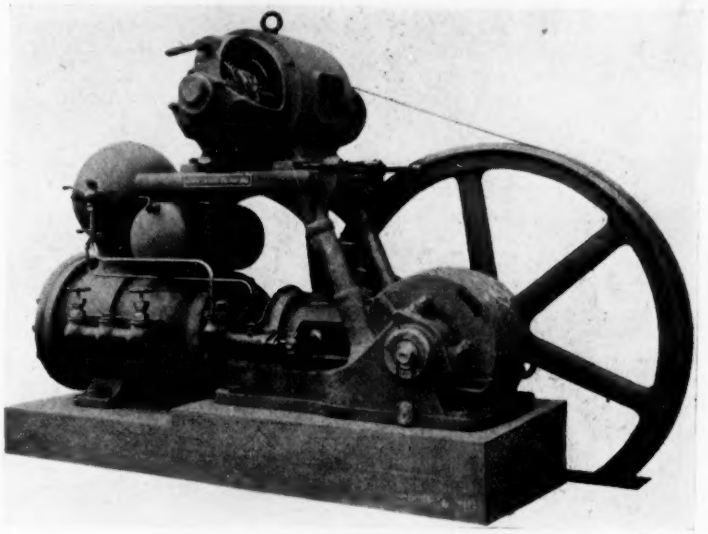


FIG. 1.—SINGLE-PLUNGER PUMP.

shaft. The compressor cylinder is designed with a large clearance space; to compress the air to the pressure required to discharge into the air vessel at the point *H* (Fig. 3), the clearance space must be filled with water. For this purpose water enters the compressor at the end of the suction stroke, when the plunger uncovers several openings in communication with the air vessel at the point *G*. The action of the compressor ceases when the water level in the air vessel is below the point *G*, and begins again when compressed air is required, namely, when the water has risen above the opening, *G*, and has entered the compressor.

For driving the pumps by means of high-speed electric motors, belts have been found most satisfactory. It is claimed that the double reduction heretofore generally required for electrically-driven pumps, with spur or worm gear, cannot compare in efficiency with

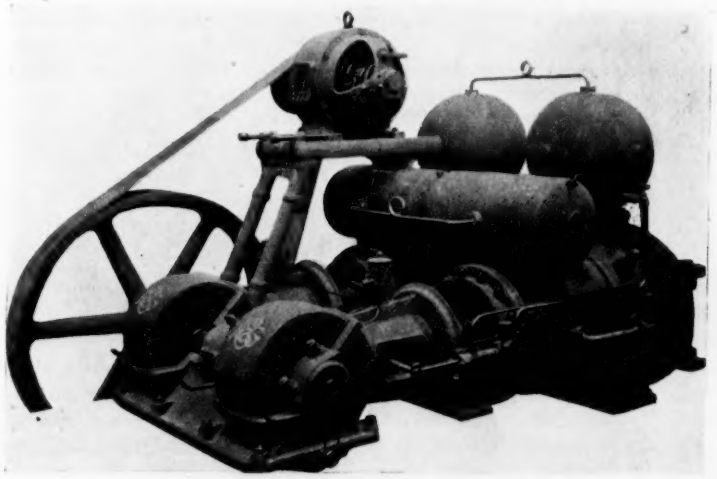


FIG. 2.—DOUBLE-PLUNGER PUMP.

the belt drive. The steadiness of the drive is assured by the heavy fly-wheel. The speed variation in the different types varies between 1.5 and 3.5 per cent. In cases where the necessity arises, the speed variation can be still further reduced by the use of a heavier fly-wheel.

The unique design of the suction chamber, where the water is retained directly in front of the suction valves, the arrangement of the specially-designed suction and delivery valves opposite each other, giving short and direct passages for the water through the pump, together with the correct choice of the velocities for the water, result in a noiseless pump, there being no hammering, even at the highest speeds. The above constructional features, together with those already described, insure not only a high efficiency, but

also greatly increase the facility for dealing with maximum suction lifts.

A pump of this design, running with a great number of strokes per minute, in comparison with a slow-running pump with long stroke, divides up the quantity of water to be delivered in a unit of time, into a correspondingly increased number of smaller deliveries. These, following each other in rapid succession, constitute more nearly a continuous delivery than that obtained from a slow-

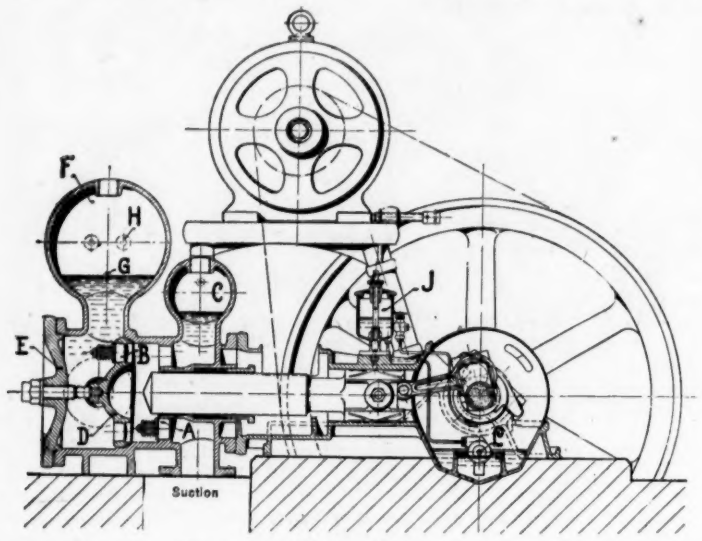


FIG. 3.—SECTIONAL VIEW OF PUMP.

running pump, even if multiple-acting. The equalization of any remaining unsteadiness of the flow of the water in the pipes is provided for by the air vessels already described.

The starting resistances, supplied for either continuous-current or three-phase motors, operate automatically to start and stop the pumps, as required in installations in which the working of the pump is intermittent; the possibility, thereby, of dispensing with the constant services of an attendant, enables considerable reductions to be made in the running costs. The arrangement is of practical application for filling and emptying tanks and reservoirs, and for hydraulic plants generally; it can also be used for starting and stopping the pump from one or more distant points.

Hartford Time Switches.

The Hartford Time Switch Company, 97 Warren Street, New York, is placing on the market two new types of time switches. The original Hartford switch, known as type "B," is the simplest form of such switches and merely provides for turning current on and off daily at the hours desired. One of the new types, known as type "C," is used for electric sign work principally, one of its functions being to omit automatically the switch throws on Sunday. The second new type, known as type "D," operates for two periods each evening—in the early evening, and when theatregoers are returning home, the light being cut out in the interim. These three types cover a range of 33 different switches, and in addition the company has designed many switches for special work, from a kind that automatically throws on a signal light for 10 seconds once a day, to others that operate only once a week. Of these special switches one which will prove of interest to central station managers is arranged to keep automatically a sign lighted for one or two hours later on Saturday night than other nights, omitting entirely the Sunday lighting if desired. The other is a small compact switch made of a capacity up to 20 amp. and designed for installation in the interior of tubular poles, such as are now being so largely adopted for street lighting purposes.

The American Electrical Salesmen Association Organized.

At the time of the Illinois State Electric Association Convention at Peoria, Ill., last week, a number of salesmen got together and organized the American Electrical Salesmen Association. The first meeting at which the organization was made was held at the Lud Hotel October 4, 1905, the organization being perfected on the following day.

This body is intended to be more than local in its character. It is believed by its organizers that an association of this kind can do good work in promoting a more fraternal spirit and better acquaintance among salesmen traveling for the electrical companies. It will be the aim of the organization to do this and to raise the standard of ethics and technical knowledge among such salesmen. The first annual convention will be held January 6, 1906, at Chicago, during the time of the Electrical Exhibition. There are no dues to be paid in the association and the management will be largely in the hands of the executive committee. The officers elected were: Vincent Gray, president, St. Louis; George H. Erich, secretary, 218 North Court Street, Rockford, Ill. Executive Committee—E. E. Rines, of Chicago; Edward Kerns, of Chicago; E. R. Wood, of Moline, Ill.

An engineering corps was elected, consisting of E. E. Rines, 2420 Indiana Avenue, Chicago; J. S. Corby, of Chicago; Thomas G. Grier, of Chicago. It will be the duty of the engineering corps to carry on whatever educational features it seems desirable to introduce, and to look after the presentation of lectures or papers.

Guy Anchor.

The accompanying illustrations show the D. & T. (drive and twist) form of guy anchor, which has been designed for use in soft earths, solid clay or sand. The anchor is driven into the ground the desired depth with a sledge or maul (Fig. 1). The blades are

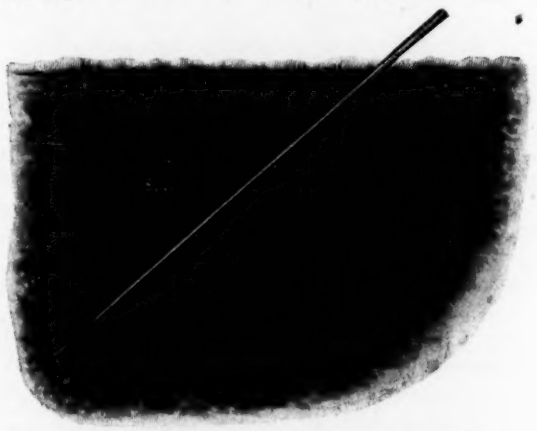


FIG. 1.—ANCHOR DRIVEN IN CLAY OR SAND.

then set by twisting to the right three revolutions (Fig. 2). The design of the blades, like those of a screw propeller, causes them to spread when the anchor is twisted. The pitch is such that they spread to an angle of 90° in three revolutions.

The spreading of the blades sinks the anchor about one inch, so that there is no lost motion in the ground. The pull is on earth that has not been disturbed.

It is stated that the anchor can be set by one man in 60 seconds.

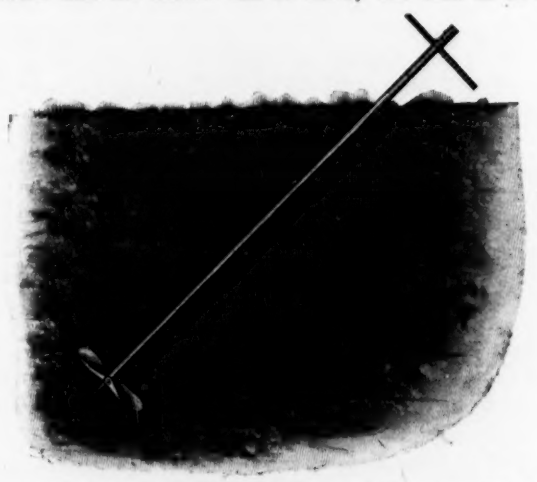


FIG. 2.—ANCHOR AFTER BEING TWISTED THREE REVOLUTIONS TO THE RIGHT.

This device is being placed upon the market by the D. & T. Anchor Company, La Crosse, Wis.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports continue favorable and there is no indication of any anxiety as to the future. Higher temperature checked retail distribution of seasonable merchandise, but preparations for heavy fall and winter trade continue with no diminution. Industrial activity increases, a large tonnage of new business assuring full time at the steel mills still further into next year, and the textile factories are busy. Better crop news weakened cotton and grain prices slightly, but there will be enormous profits to the growers even if quotations go still lower. No serious weakness is feared, no matter how large the production, owing to the interest of exporters. Complaints as to car shortage increase, the grain, coal, coke, iron and lumber trades all reporting congestion from this cause. Undiminished activity is witnessed in the iron trade, demand for crude and finished products surpassing previous years at this period. Higher levels of future cost, particularly as to coke and ore, confront these trades. Collections for the country in general are good. Taken as a whole, Southern trade advices are better, and some markets free from yellow fever quarantine restrictions, which, by the way, are being relaxed, report distinct improvements in trade and collections. A downward turn in prices of agricultural products was in evidence, a result of the pressure of new large crops of fine quality. There were free buying and large shipments of dry goods, clothing, groceries, shoes, hardware and lumber in all leading Western and Northern markets. Free buying of pig iron was again a feature of the week at leading markets, advances of 25 to 50c. per ton being noted at some points, and prices still tending upward. Steel billets are 50c. to $1 higher, and light rails have advanced $1. Records were broken in the August exports of various iron and steel material made through New York. Hitherto such shipments have been sent abroad principally through Philadelphia and Baltimore, but in August New York handled about two-thirds of the entire consignments made to various parts of the globe via Eastern seaboard points, or 42,117 tons out of a total of 58,764 tons of steel rails, billets, beams, blowers, wire, wire nails, and pipe which left these shores. The shipment embraced the largest single consignment that has ever left any American port. The different countries to which exports were made were Great Britain, Ireland, Australia, Mexico, Argentine Republic, Chile, Belgium, Holland, Denmark, Norway, Sweden, Germany, Italy, Central America, South Africa, Canada, China, Japan, Philippine Islands, Dutch East Indies, Ceylon and Greece. In all, 27,443 tons of steel rails went forward, the Argentine Republic taking 13,306 tons. Cuba was a purchaser to the extent of 8,838 tons. Mexico, notwithstanding the recently inflicted additional tariff, took three lots, amounting to 3,450 tons, while Chile got 1,749 tons. The steel billets went principally to England. The September exports of wire, wire nails, and pipe exceeded 14,000 tons. The wire shipments also amounted to 7,835 tons. Australia was the principal buyer, taking 4,728 tons. The September nail shipment amounted to 1,865 tons, which went mostly to England. More than 4,300 tons of pipe went abroad last month, 2,030 tons of which went to Europe. Lead and copper are higher. There was a good demand for copper and consumers paid 16⅝c. for Lake and electrolytic for immediate shipment. Special brands command ⅛ to ¼c. more. *Bradstreet's* reports 189 business failures during the week ending October 5, against 185 the week preceding, and 195 in the corresponding week last year.

THE BALL & WOOD COMPANY, 17 Battery Place, New York, has recently added to its works at Elizabethport a plant for turning out welded flanged pipe and pipe bending. The company is now in position to meet the demand of contractors and engineers for a pipe joint to withstand the higher steam pressures coming into use, due to the increasing preference for superheated steam. It will do no pipe fitting and will undertake no piping contracts, but is prepared to quote prices and fill orders for the material used in this line of work. In its new plant the Ball & Wood Company has endeavored to avail itself of the latest improvements in every line of equipment, not only in making the joints and bends but in handling the material. A new building has been erected, in which all the tools are driven electrically. Heavy, high-speed lathes, facing tools, multiple drills have been installed, and through the use of the new tool steels the largest flanges are faced and drilled quickly and accurately. Electric cranes, oil furnaces and modern hammers complete the equipment for turning out work promptly. After this work is completed every joint is tested under hydraulic pressure to the required specification before it is shipped and the result of this test is stencilled on the pipe.

TROLLEY IN IOWA AND TEXAS.—Engineers Cason & Barrett, of Kansas City, Mo., state that the survey of the proposed route for an electric railway between Fairfield, Birmingham and Keosaqua, Ia., proved the route impracticable from both an engineering and financial standpoint and was therefore abandoned. A new survey was started, however, for a route between Fairfield and Keosaqua via Stockport. By connecting Fairfield and Keosaqua through Stockport instead of Birmingham, the road will be about thirty miles instead of twenty. Mr. Henry S. Hackbusch, civil engineer for Cason & Barrett, is still retained in charge of the field party. The firm has also just signed a contract for preliminary survey and investigation of the proposed electric interurban road connecting Corsicana, Fairfield and Palestine, a distance of 75 miles. Mr. J. V. Watkins, of Corsicana, is promoting the enterprise, and states that he has capital enough back of him to swing the undertaking easily. The route has already been looked over and Messrs. Cason & Barrett state that they will probably have their corps of engineers at work on the survey by Oct. 15, 1905.

BIDS WANTED.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until October 20, to furnish at the navy yards at New York, N. Y., 31 motor-generators, 2 to 15-kw, 80 to 220-volt, seven alternating armatures, 2 to 5-kw. Bids will also be received until October 24 at the same Bureau to furnish at the navy yards at Portsmouth, N. H.; Boston, Mass.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C., and Norfolk, Va., navy supplies as follows: Electrical cable, incandescent lamps, electrical supplies, thermostats, sockets, wire, conduit and fittings, etc. Address H. T. B. Harris, Paymaster-General, U. S. N.

NAVY SUPPLIES WANTED.—Bids will be received until October 17 at the Bureau of Supplies and Accounts, Navy Department, Washington, to furnish at the navy yards at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C. and Norfolk Va., incandescent lamps, electrical supplies, double conductor switch stands; outlet boxes, Holophane hemispheres, wireless clusters, electric deck hoists, steel conduit, drilling and milling machine, power trimming press, sheet press, bar steel, etc. Address, H. T. B. Harris, Paymaster-General, U. S. N.

EXPORT TRADE LARGE.—Up to August 31, 1905, imports amounted to $770,412,026, as against $667,269,364 in the preceding year; and exports were valued at $966,612,607, as compared with $851,203,457 in the first eight months of 1904. The value of manufactures exported during the first eight months of 1905 practically equaled the total exports of manufactures during the entire calendar year 1899, being $376,198,670, as against a total of $380,787,891 for the entire year of 1899. Should the commercial activity indicated by the August figures continue during the succeeding four months, the calendar year 1905 will show the largest volume of commerce, both as to imports and exports, ever recorded.

BIDS FOR TURBINES.—The following are reported to be the bids opened on October 4 by the Board of Bond Trustees, Jacksonville, Fla., for furnishing two 500-kw steam turbine generators, with necessary equipment, for the extension of the city lighting plant: General Electric Company, $38,963; Providence Engineering Works, of Providence, R. I., $40,945; Allis-Chalmers Company, $36,135; Westinghouse Machine Company, Pittsburg, Pa., $36,767 for bid "A" and $35,367 for bid "B." Warren Electric Manufacturing Company, Sandusky, Ohio, $31,925; two bids, single flow and double flow, same for each.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Mt. Pleasant, Ill.; Hunter, N. D.; Union, Miss.; Harris, Pa.; Des Moines, Ia.; Roann, Ind.; Tower Hill, Ill.; Milacca, Princeton, Foley, North Branch, Rush City, Mora, Forest Lake, Grandy, Lindstrom, Braham, Minn.; Olathe, Kan.; Rochester, N. Y.; Truro, Ia.; Kalama, Wash.

THE ROBINS CONVEYING BELT COMPANY has recently secured through Messrs. J. G. White & Co., of New York, the contract for the belt conveyors for the U. S. naval coaling station at Olongapo, Philippine Islands. The Robins Co. is also constructing a belt conveyor for handling coal for the Lackawanna Steel Company's plant at Buffalo, and expects to ship shortly a large order of belt conveyors for the Santander Iron Mines, Santander, Spain.

PRICES WANTED.—Lawson, Sykes & Company, Courtland, Ala., want prices on machinery and equipment for an electric light plant.

G. E. RAILWAY MOTORS.—The General Electric Company reports a large demand for its railway motors, as indicated in the following list of recent contracts: The Central Illinois Construction Company, Decatur, Ill., has added two four-motor, 65-hp, and two four-motor, GE-73, 75-hp Sprague-General Electric type M control equipments complete. The South Bend & Southern Michigan Railway Company, South Bend, Ind., has ordered five four-motor, GE-74, Sprague-General Electric Type M control equipments. The Columbus, Delaware & Marion Railway Company, Delaware, O., has ordered three GE-73 type M equipments and one four-motor, GE-1000 equipment, with K-6 controllers, while the Interurban Railway Company, Des Moines, Ia., has ordered eight 4-motor, GE-73 Sprague-General Electric type M control equipments, and the San Francisco, Oakland & San Jose Railway, Oakland, Cal., has ordered three two-motor GE-66 (125 hp) equipments of type M control, which are in addition to 14 equipments already in operation on this road. The San Antonio Traction Company, Texas, has ordered 12 two-motor, GE-67 equipments with K-10 controllers. The Galveston City Railway Company, Galveston, Texas, 17 GE-54 motors with K-10 controllers. The Northern Texas Traction Company, Cleveland, O., 10 two-motor, GE-54 equipments with K-10 controllers. The New York City Interurban Railway Company has added 10 four-motor, GE-80-A, 38-hp equipments with K-33 controllers to its present equipment. The Philadelphia Rapid Transit Company has also ordered five two-motor, GE-80 equipments. The Scranton Railway Company, Scranton, Pa., also ordered 30 GE-80 motors. The Syracuse Rapid Transit Company has ordered nine four-motor, GE-67 equipments with controllers. The Memphis Street Railway Company, Memphis, Tenn., has added 35 four-motor, GE-57 equipments. The Rochester Railway Company has added six four-motor, GE-54 equipments, making a total of 86 of these 25-hp motor equipments on its lines. The Kanawha Traction Company, Charleston, W. Va., has ordered six two-motor, GE-57 equipments, and the Gulfport & Mississippi Coast Traction Company, Gulfport, Miss., 12 four-motor, GE-57 equipments with K-14 controllers. The United Railway of San Francisco has added 50 four-motor, GE-1000 equipments with K-4 controllers.

POWER PROJECTS AT DULUTH.—It is stated by the *Iron Age*, that the General Electric and Westinghouse Electric companies are formulating plans for the electrification of Proctor Hill, on the Duluth, Missabe & Northern Railroad. This is a 2 per cent grade for about six miles, running from the shipping docks of the company on the harbor of Duluth to the terminal and transfer yard of the company at Proctor, Minn. Loaded ore trains from the mines are run to Proctor and there taken by switch engines down to the docks. The same engines bring back empty cars, which are made up for the return trip to mines at Proctor yard. About 2,500 will be required for handling trains on this grade, and if arrangements are made with either company for an installation the power will be furnished by the Great Northern Power Company, which is now building its hydro-electric works at Duluth. It is not yet determined whether alternating or direct current will be used in this work. The same companies are also working out plans for the possible electrification of the Duluth-St. Paul line of the Northern Pacific Railroad. This line connects Duluth and Superior with Minneapolis and St. Paul, and is about 165 miles in length, with a very heavy freight and passenger traffic. With the exception of a 1 per cent grade out of Duluth, and slightly steeper entrance into St. Paul, the line is reasonably free from gradients. It is one of three steam lines connecting these cities and carries an immense amount of coal and package freight as well as some grain, and runs several passenger trains each way daily. The second project is not so sure as the first and may not come for a considerable time. The successful electrification of the Duluth, Missabe & Northern's terminal line will mean that electrical railroading will be extended to the entire length of that line as well as to both the other roads reaching from the iron ore ranges to Duluth.

Financial Intelligence.

THE WEEK IN WALL STREET.—The rise in rates for money and the consequent restriction upon the market checked speculative activity in stocks and prices were inclined to ease off in spite of manipulative support by large interests. There was an evident disposition to bring industrials into more prominence, but this was limited by the money market conditions. Notwithstanding these, however, the market showed a decided disposition to recover ground. United States Steel stocks throughout the week appeared to be well supported, the buying of common being especially good. Common and preferred both reached the highest prices of the year, viz., 39 for the former and 105⅞ for the latter. Traction securities received some attention under the lead of Brooklyn Rapid Transit, but the gains were subsequently lost. Brooklyn Rapid Transit touched 73⅜ but closed at 71¼, which is a net loss of 1⅛ points. Metropolitan Street Railway made a slightly better showing, closing at 126½, a net gain of ⅝-point. Interborough Rapid Transit was the greatest sufferer of all the tractions, the closing price, 210½, representing a net loss of 5¼ points. The electric securities were generally weak and little was done in them. Allis-Chalmers common closed at 18, a net decline of ½, and preferred at 60½, a gain of ½-point. General Electric lost 1 point net on the week's business, closing at 180½, and both the Westinghouse stocks closed with a net decline of ½-point each, common closing at 169½ and preferred at 194½. Western Union was inactive, closing at the lowest quotation of the week—98⅜. American Telephone & Telegraph is unchanged at 138½, and American Telegraph & Cable is off ¾-point, the closing price being 92¼. Four hundred shares of Electric Storage Battery sold at prices ranging between 85¼ and 84½, the closing quotation being 85, which is a net gain of ¾ over the closing quotations of the previous week. The curb market during the week held fairly well considering the heaviness of the Stock Exchange list during a large part of the time. There was less liquidation on the curb, and it was not affected to any extent by the money market, because call loans are rarely made on unlisted stocks. Standard Oil scored a rather sensational rise, following up the movement of the previous week. The rise during the present week amounted to more than 30 points, making about 40 points in two weeks. The closing quotations of October 10 are given in the subjoined table:

NEW YORK

	Oct. 4	Oct. 11		Oct. 4	Oct. 11
Allis-Chalmers Co.	18	17⅝	General Electric	182	180½
Allis-Chalmers Co. pfd.	60¼	60⅜	Hudson River Tel.	..	..
American Dist. Tel.	32	32	Interborough Rap. Tran.	213	213
American Tel. & Cable	92	92	Mackay Cos.	46⅜	46⅜
American Tel. & Tel.	138	138	Mackay Cos. pfd.	74	74¼
Brooklyn Rapid Transit	72⅜	71⅛	Marconi Tel.	..	..
Electric Boat	30	30	Metropolitan St. Ry.	126⅜	127
Electric Boat pfd.	70	70	N. Y. & N. J. Tel.	..	..
Electric Lead Reduction	..	..	Western Union Tel.	98⅜	98⅜
Electric Vehicle	17	18	Westinghouse com.	168¼	167½
Electric Vehicle pfd.	22	23	Westinghouse pfd.	..	..

BOSTON

	Oct. 4	Oct. 11		Oct. 4	Oct. 11
American Tel. & Tel	139½	137½	Mass. Elec. Ry. pfd.	58¾	57
Cumberland Telephone	121	121	Mexican Telephone	1⅜	1⅜
Edison Elec. Illum.	250	249	New England Telephone	137	136
General Electric	181	179	Western Tel. & Tel.	14	14
Mass. Elec. Ry.	13	14	Western Tel. & Tel. pfd.	95	95

PHILADELPHIA

	Oct. 4	Oct. 11		Oct. 4	Oct. 11
American Railways	52⅛	52⅛	Phila. Electric	9	8⅞
Elec. Co. of America	11⅜	11¼	Phila. Rapid Trans.	28	27¾
Elec. Storage Battery	84	82	Phila. Traction	..	..
Elec. Storage Battery pfd.	..	..			

CHICAGO

	Oct. 4	Oct. 11		Oct. 4	Oct. 11
Chicago City Ry.	200	..	National Carbon	63	61
Chicago Edison	..	160	National Carbon pfd.	..	..
Chicago Subway	..	..	Union Traction	..	..
Chicago Tel. Co	..	..	Union Traction pfd.	..	..
Metropolitan Elev. com.	25⅛	..			

* Asked.

WELSBACH ANNUAL REPORT.—The annual report of the Welsbach Co. shows that it earned $17,307 more net profit for the fiscal year just ended than in 1904, when the company's business felt the effect of the commercial depression. The company's policy has been to push the sales and be content with a smaller margin of profit on the goods, thus putting the business on a more stable basis. This resulted in 1905 in an increased volume of business and of net earnings as well. The net earnings are the largest of the present company in any year except 1901, when they were $625,837. The $7,000,000 bonds are getting the benefit of the operations of the sinking fund which has now acquired nearly $1,000,000 of the bonds, and after meeting the sinking fund requirements, charging off something to depreciation and paying the usual September dividend of 2 per cent., the company was able to carry forward a small surplus. The United Gas Improvement Company owns control of the $3,500,000 stock. The present price for the bonds is about 65 and for the stock 24.

AURORA, ELGIN & CHICAGO.—Plans are being matured for the retirement of the $1,500,000 of the preferred stock and the substitution of $2,000,000 of 5 per cent bonds. The original bond issue was $3,000,000, which was to cover the cost of the property. The purchase of an expensive private right of way, which is 100 feet wide, the laying of the track on stone ballast with very heavy rails and the elaborate equipment of the power house brought the cost $1,700,000 above the expectations and up to $4,700,000. To make the bond issue equal to the value of the property it is to be increased to $5,000,000 and the cumulative preferred stock is to be retired. This gives to the common stock all of the value of the surplus above fixed charges. Present earnings of that property show a satisfactory gain in both gross and net earnings.

THE MEXICAN TELEGRAPH COMPANY shows gross earnings for the quarter of $136,000 and net of $108,500. The Central & South American Telegraph Company shows gross earnings for the quarter of $316,000 and net of $210,500.

BOSTON EDISON REPORT.—The Edison Electric Illuminating Co., of Boston, has issued its report for the year ended June 30, 1905. The meeting of stockholders was held this week. The income account compares as follows:

	1905.	1904.	1903.	1902.
Gross	$3,346,027	$3,125,516	$2,667,808	$2,460,158
Expenses	2,143,106	2,009,691	1,683,085	1,510,427
Net	1,202,921	1,115,825	984,723	949,731
Miscellaneous profits	33,286	37,396	32,502	25,981
Total increase	1,236,207	1,153,221	1,017,225	975,712
Interest and dividends	1,164,791	1,075,813	955,970	859,614
Surplus	71,416	77,498	61,255	116,098

Lamps and motors connected as of June 30, 1905, compare as follows:

	1905.	1904.	1903.	1902.
Incandescent lamps	708,384	627,441	493,402	442,034
Arc lamps	10,102	9,358	8,196	8,548
Motors, horse-power	26,416	24,150	20,801	19,130

Of the increase shown for the fiscal year just closed 57,509 incandescent lamps, 493 arc lamps and 2,017 horse-power of motors were added in the purchase of the Woburn Light, Heat & Power Co. The remainder is the increase in new business for the year. President Charles L. Edgar says: "The growth of the company in lamps and motors during the year has been satisfactory. During the year the property of the Woburn Light, Heat & Power Co. has been purchased and a contract entered into with the Newton & Watertown Gas Light Co. for supplying that company with all its electricity until such time as the final purchase of its electric property is consummated. The new turbine power station has been in successful operation since last fall, the installation of two 5,000-kw units having been completed at that time. Another unit of the same size has recently been ordered and will be installed during the summer of 1906. The old generating station at Framingham has been discontinued and the property is for sale. The steam stations at Natick and Somerville have been turned into sub-stations, the steam apparatus being retained as a reserve. The steam stations located at Head place and Hawkins street have been turned into sub-stations and the apparatus disposed of, all of which is reflected in the decrease in the reserve for maintenance account shown in this year's balance sheet."

PENNSYLVANIA ELECTRICS.—The merger, recently announced in these columns, of the Pennsylvania and Mahoning Valley Railway Company, operating the New Castle and interurban lines of Youngstown, Niles and Warren, and the Sharon and New Castle Street Railway Company, controlling the local lines of Sharon and interurban lines to Youngstown and New Castle, has been ratified by the stockholders. It was decided to accept the offer made by J. W. Blackburn, of Youngstown, Mr. Barton, of Cleveland, and others, for the transfer of the properties of the two concerns. The new company is the Mahoning & Shenango Railway, Light & Heat Company. The deal involves about $5,000,000 worth of railway property and valuable franchises. The company will expend about $3,000,000 in improvements and extensions, as soon as stock to the amount of $10,000,000 is issued. One of the extensions will be a line from New Castle to Mercer through New Wilmington. It is also announced that the deal has practically been closed for the sale of the Titusville Traction Company to Murray A. Verner, of Pittsburg, and the McClure syndicate of Philadelphia. This means a consolidation of all electric light and street railway companies in Crawford County and eventually all the lines in western Pennsylvania and eastern Ohio will be merged and under control of one company, headed by Philadelphia, New York and Pittsburg capitalists. It is said that when all the lines are united it will represent properties which will be capitalized at $15,000,000.

LARGE WESTERN TROLLEY DEAL.—In Philadelphia, papers have been signed transferring four important Western traction companies to a Philadelphia syndicate headed by Randal Morgan, of the United Gas Improvement Company. The properties and the securities outstanding upon them are as follows:

	Bonds.	Pfd. stock.	Com. stock
Ind. N. W. T. Co.	$2,500,000	$450,000	$2,500,000
Ind. & Western	1,500,000	750,000	1,250,000
C. B. Lake & Newark	1,250,000	500,000	1,000,000
C. New. & Zanesy	1,250,000	400,000	850,000

All of these roads were built, financed and managed by Tucker, Anthony & Company. Negotiations have been pending since the early part of August. It is understood that the sale involves the transfer of about $14,000,000 in cash and securities. While these properties are not sold to the United Gas Improvement Company, as a company, the fact that the Improvement Company has large traction interests in Indiana and Ohio which connect with the above four roads, makes it quite possible that they will in time turn up in the ownership of these properties.

ELECTRIC STORAGE BATTERY.—The English subsidiary of the Electric Storage Battery Company has issued its annual report, and the figures show that the year just closed was the best in the history of the plant. Dividends of 6 per cent. on the preferred and 8 per cent on the common stock, were paid, but earnings were sufficient to pay about 70 per cent on the common, which very high rate was, of course, due to the small amount of this issue. All of the common stock of the English company is owned by the American company. The reason the larger part of this 70 per cent earned on the common stock of the English company was not paid, was that it is intended to pay off the bonded debt, which matures next December, and which will be provided for entirely out of cash in bank, leaving the company entirely free of any debt whatever. In this respect the American and English companies will thereafter be similarly circumstanced, as the parent company has no debts of any kind.

DIVIDENDS.—Stone & Webster report that a semi-annual dividend of 75 cents on the preferred stock of the Houghton County Electric Light Company and a dividend of 50 cents on the common stock are payable November 1. The directors of Standard Underground Cable Company have declared a quarterly dividend of 3 per cent, payable Oct. 10. The Hudson River Telephone Company has declared the regular quarterly dividend of 1½ per cent, payable Oct. 14. Stone & Webster state that a semi-annual dividend of $2.50 per share has been declared by the Edison Electric Illuminating Co. of Brockton and a semi-annual dividend of $4 per share by the Lowell Electric Light Corporation. Both dividends are payable November 1 to stock of record October 12.

SALE OF PADUCAH PROPERTIES.—Stone & Webster have purchased the street railways, electric light and gas companies of Paducah, Ky., and have combined them under one management under the name of the Paducah Traction & Light Co., incorporated under New Jersey laws. The combined earnings for 1905 and 1906 (estimated) follow:

	1905.	1906.
Gross earnings	$225,000	$270,000
Operating expenses (65%)	126,250	(60%) 162,000
Net earnings	78,750	108,000
Fixed charges	.....	63,000
Net profit	.....	45,000

KANSAS INTERURBAN TROLLEYS.—Mr. James T. Manning, of the Kansas City Oil Supply Company, has succeeded in financing the interurban trolley line of which he is president, and work is to begin within sixty days. Mr. Manning says that the work of constructing the new road would be started within sixty days. The length of the line will be sixty-four miles and the maximum grade 4 per cent. A contract for the grading has been let to the Tonganoxie Construction Company. The name of the interurban company is to be the Kansas City, Lawrence & Topeka Short Line. The officers of the organizing company are James T. Manning, E. M. Lambkin, Martin Gallagher, Easton, Kan.; W. Laning, Tonganoxie.

CHICAGO NORTHWESTERN "L."—The Northwestern Elevated Railroad of Chicago has issued its report for the year ended June 30, 1905. The income account follows:

	1905.	1904.	1903.	1902.
Gross	$1,786,414	$1,724,929	$1,642,456	$1,499,014
Expenses	616,628	566,076	517,441	425,061
Net	$1,169,786	$1,158,853	$1,125,015	$1,073,953
Changes, taxes, etc.	952,627	955,599	941,605	922,322
Surplus	$217,159	$203,254	$183,410	$151,631
Earnings on $5,000,000 preferred stock	4.34%	4.06%	3.67%	3.03%

CUYAHOGA TELEPHONE.—The earnings of the Cuyahoga Telephone Company for the six months ending June 30, 1905, have been as follows:

Gross		$273,375
Expenses	$143,707	
Taxes	9,973	
		153,680
Net earnings		$119,695
Deductions		72,009
Surplus for six months		$47,686

CONSOLIDATION IN HELENA.—J. G. White & Company and associates, who recently purchased the stock and bonds of the Helena Light & Traction Company, have incorporated the Helena Light & Railway Company under the laws of Connecticut with $1,500,000 of authorized capital stock, of which $900,000 is common and $600,000 is 5 per cent cumulative preferred; present issues, $561,000 common, and $374,000 preferred stock. A mortgage has been made to the Knickerbocker Trust Company, of New York, to secure an authorized issue of $1,500,000 twenty-year 5 per cent gold bonds of $1,000 each, maturing September 1, 1925.

General News of the Week

The Telephone.

NEW CASTLE, ARK.—The New Castle Telephone Company has been formed, with a capital of $1,700, by J. L. McDougal, president; W. J. Dillon, secretary.

SAN FRANCISCO, CAL.—The Pacific States Telephone Company's exchange in Berkeley, Cal., is threatened with a strike, because a Japanese girl has been employed, there being a scarcity of operators.

SANTA BARBARA, CAL.—The city service of the Sunset Telephone and Telegraph Company will be completely overhauled and a new line built to San Francisco. A line is also to be built from San Francisco to Los Angeles.

SAN FRANCISCO, CAL.—The City Trustees of Berkeley, Cal., have closed a contract with the Signal Phone Company, of Milwaukee, Wis.; the Kilbourne-Clark Company, Pacific Coast agents, for a complete police patrol telephone system. Twenty boxes and a switchboard will be installed.

SAN FRANCISCO, CAL.—The Pacific States Telephone & Telegraph Company is rapidly completing three fire-proof brick buildings in San Francisco. The company has purchased real estate at these centers for future exchanges. The growth of the system for fifteen years to come has thus been planned. All of the underground conduit work now being installed is done with provision for the needs of this period in the future. With the opening of the new 8-story telephone exchange on Bush street near Grant avenue, next March or April, the new common-battery, multiple-switchboard system will be used throughout the city and the old apparatus abandoned. The new switchboards and buildings will cost $1,775,000, and the entire expense of the betterments will reach $2,000,000. There are over 47,000 telephones in use in the city. The East office and the West office are now being operated with the new equipment, giving about 14,000 subscribers an improved service. The South office on West Mission Street, near 11th, will begin operations in January, with probably 10,000 subscribers connected. The switchboard can take care of 18,400 telephones. A considerable increase in the number of subscribers is expected as soon as the changes have been made, and the new offices will accommodate a total of 60,000 main loops. The executive offices will be moved to the new general office building on New Montgomery Street, between Mission and Howard, which will be completed in December.

FLORENCE, COL.—The Colorado Telephone Company will build a new line from this city to Querida via Wetmore and Greenwood.

LEWISTON, IDAHO.—The Pacific States Telephone Company will make improvements in its system in this city to the amount of $21,000. Protests against the company's present service are believed to have led to the decision.

ATHENS, ILL.—The farmers on the Sugar Point telephone line sold out their telephone interests to the independent company.

SPRINGFIELD, ILL.—The Central Union Telephone Company will lay its wires underground at Springfield at a cost of $100,000. It is said that the Central Union and the Home Telephone Companies will spend about $100,000 in improvements in their service in the twin cities.

ADVANCE, IND.—The Max Co-operative Telephone Company has been granted a franchise by the Advance town council to build lines in that place.

INDIANAPOLIS, IND.—The Indianapolis Telephone Company has just installed a new private branch exchange switchboard in the new post-office and court house building. There are 50 local stations. The Central Union Telephone Company has also installed a similar plant in the same building.

KOKOMO, IND.—Despite the refusal of the City Council to amend the franchise of the Citizens Telephone Company so as to permit it to enter into a long-distance service contract with the Central Union Telephone Company, the service has been instituted and it remains to be seen what effort, if any, will be made to forfeit the property to the city.

EVANSVILLE, IND.—The case of the Cumberland Telephone Company against the city of Evansville has been set for argument in the United States Circuit Court of Appeals in Chicago on Nov. 7.. The suit arose out of an attempt to oust the company from the streets of the city on the alleged ground that the company's franchise had expired. The city won in the trial courts and the company appealed. The matter has been in litigation for over two years.

CONVERSE IND.—The Converse Telephone Company, which for the past five years has been a sublicensee of the Central Union Telephone Company, has severed its connection with that company, the contract having expired. The company has entered into a long-time contract with the New Long-Distance Telephone Company, of Indianapolis, and the Delaware County Telephone Company, of Muncie, for service over their respective lines and connecting exchanges.

LAFAYETTE, IND.—A deal has been consummated whereby the Tippecanoe Telephone Company's system passes to the ownership of the Central Union Company for a consideration of $22,000. The deal gives the Bell Company 180 miles of wire from this city to Crawfordsville, running through the villages of Romney and Linden and a good agricultural district. The system was built by Dr. Pyke, of Romney, who began with seven telephones ultimately building north to Lafayette and south to Crawfordsville. Mr. Pyke said he would have preferred to sell to the local independents, but they were too slow in considering the matter. The local independents say they do not need the line, since they have another competing line covering the same territory and now controlling the bulk of the business, besides the line just sold is old and out of date, fit only for junk.

DES MOINES, IA.—The Mutual Telephone Company has increased its rate for direct business telephones from $36 to $42 per year. The two-party line service remains unchanged at $36 per year.

CHANUTE, KAN.—The Home Telephone Company of Kansas City, which is the parent of the Kansas City Long Distance Telephone Company, has made a proposition to take over the Chanute exchange and the exchanges in Erie, St. Paul, Galesburg, Thayer, Humboldt and two or three other rural lines. It is the object of the Kansas City people to secure all the local exchanges in this part of the State.

PADUCAH, KY.—The plant of the People's Independent Telephone Company has been sold by Special United States Commissioner E. W. Bagby.

PADUCAH, KY.—The City of Paducah, Oct. 6, filed suit to oust the East Tennessee Telephone Company from the city on the ground that it has no franchise. The East Tennessee is operated by the Cumberland, and the suit marks the beginning of a war between the Cumberland and the independent lines here.

BOSTON, MASS.—The Massachusetts Telephone Company has just completed the laying of its main in the leather district of Boston, and is now making an active canvass of the leather trade for subscribers. The company has for several years supplied a large number of the wool houses with a service. At the present time the company has slightly less than 800 subscribers, whereas its central switchboard has a capacity of 1,800 lines. All of the service supplied is unlimited, with private lines to each subscriber at a cost of $48 a year. Although the company's charter permits it to operate anywhere in the state of Massachusetts, and it has already obtained franchises from 63 towns, it has so far opened but two exchanges aside from the local one, these being in Stoughton, where 100 subscribers have been obtained, and Taunton, where 300 connections have been made. The Massachusetts Telephone Company is controlled by the Telephone, Telegraph & Cable Company of America.

ST. JOHNS, MICH.—The Laingsburg Telephone Company has added 197 new telephones to its system since April 1. The average increase for September has been 3 per day

EMMET, MICH.—The Michigan Telephone Company is constructing a line out of Emmet and through Wales to Thornton, which, when completed, will cover St. Clair County.

MORA, MINN.—The Tri-State Telephone Company has bought the local exchange and will remodel and improve it.

ST. JAMES, MINN.—The St. James Telephone Company has been formed. Capital, $25,000. Incorporated by H. M. Serkland and P. N. Sterrie.

MINNEAPOLIS, MINN.—The Northwestern Telephone Company will this fall enlarge its present building at Fifth Street and Third Avenue south.

GARFIELD, MINN.—The Farmers and Merchants Co-operative Local Telephone Company has been formed with a capital of $10,000, by Peter Engstrom and Gustaf Loo.

ST. PAUL, MINN.—By a deal the Twin City or Tri-State Telephone Company takes over 300 miles of line in northern Minnesota and Wisconsin, covering 16 exchanges and rural lines and giving the purchasers a practical monopoly of the telephone situation in ten counties. The property was formerly managed by the Minnesota Mutual Telegraph and Telephone Company. Heretofore all business over these lines and connecting points has come into the twin cities over the lines of the Northwestern Telephone Company. The territory covered by this new deal includes Pine, Mille Lacs, Benton, Isanti, Chisago and Washington counties in Minnesota and Burnett and Polk counties in Wisconsin.

JACKSON, MISS.—The Mississippi Telegraph Company has applied for a charter of incorporation; capital, $25,000; to run a line from Jackson, Miss., to West Point, Miss., about 200 miles. W. T. Naff and J. S. Anderson, Jackson, Miss., are the incorporators.

HELENA, MONT..—Extensive improvements are to be made in the local system of the Rocky Mountain Bell Telephone Company, including the installation of a new 800-line switchboard.

ST. LOUIS, MO.—The Telephone Construction Company has filed articles of incorporation. The capital stock is $15,000, full paid. The incorporators are R. F. Spencer, Charles Sutter, J. H. Murphy, J. L. Hermann and J. J. Schatzman.

ST. JOSEPH, MO.—An organization of District No. 1 of the Missouri Independent Telephone Association, which includes St. Joseph and the counties of Buchanan, Atchison, Worth, Nodaway, Gentry, Harrison, Andrew, De Kalb, Clinton and Holt has been effected.

ST. LOUIS, MO.—The approximate number of subscribers to the Bell Telephone service in the city of St. Louis is now put at 25,000, the largest in the history of the company. Despite sharp opposition there has been a considerable gain right along in the amount of business done by the local Bell corporation. The long-distance service has also been extended materially during the past six months, lines being strung throughout many parts of the Southwest hitherto barren of telephone communication.

KANSAS CITY, MO.—One hundred and forty men, employees of the Bell Telephone Company, representing all departments, met at the Coates House, Kansas City, and organized the Bell Telephone Society. The following officers were elected: L. A. Mack, president; S. A. Butler, Jr., vice-president; Charles Bozard, secretary; N. Harris, treasurer; E. J. Richards, chariman of the entertainment committee; J. F. Marshall, chairman of the

membership committee, and R. L. Shaw, chairman of the executive committee. The club expects to have a membership of 300 in the near future.

ST. LOUIS, MO.—Plans for financing the new United States Independent Telephone Company, the $50,000,000 corporation organized to consolidate the independent telephone systems in a number of cities, including St. Louis, are progressing rapidly. The Western end of the merger is being handled by the Mississippi Valley Trust Company, which is apportioning the underwriting of the securities for all the territory outside of New York State. Breckenridge Jones is in New York representing the Kinloch directors at a meeting of the interests, which is expected to perfect the merger. It is statd that it has not been determined so far whether the Kinloch company will be absorbed by the United States, but in any event the local company will be in a long-distance service agreement which will make it a part of the working system. An issue of $17,000,000 in collateral trust bonds is to be the basis of the financial scheme. About $1,500,000 of the bonds will be placed in St.. Louis and the rest apportioned among other cities.. A bonus in stock of the company is given to the purchasers. The underwriting figure is withheld at present. The companies already absorbed are located at Indianapolis, Cincinati, Louisville, Cleveland, Pittsburg, Rochester and Philadelphia. Valuations at which the stock of these companies is to be taken over have been fixed and the payment will be made in cash or securities, at the option of the holder.

LINCOLN, NEB.—The Steinauer Telephone Company, which was incorporated in 1900, has amended its articles of incorporation by increasing the capital stock from $3,000 to $25,000.

CANTERBURY, N. H.—The town of Canterbury, acting through the board of selectmen, has refused to allow the New England Telephone & Telegraph Company a right to build a line through the town, and the company, through its attorneys, has filed an appeal with the superior court. So far as is known, the town is the first in New England to refuse a franchise to the Bell Company. The action of the town is based on the claim that the exclusive right to establish a telephone line in the town has been granted to an independent company.

CAMDEN, N. J.—The Southern Telephone Development Company has been incorporated here with a capital of $100,000.

JERSEY CITY, N. J.—The Coast Line Telephone Company, which is a Jersey City independent concern, has sent out notices offering free service for six months to all subscribers who will be willing to pay $1 a month for unlimited service for one year thereafter. It is said that this company has secured 7,000 subscribers through this offer. The Coast Line concern was formed last spring, and will cover a territory in the State thirty miles west from the Hudson River. D. A. Reynolds is the president, and the main offices are at 15 Exchange Place, Jersey City. Mr. Reynolds is also manager of the Atlantic Telephone Company, which proposes to do an independent business in Greater New York, except Staten Island, with another concern, to be known as the State Line to operate in Westchester County.

LOWVILLE, N. Y.—The Central New York Telephone & Telegraph Company will operate a telephone exchange in Lowville.

BUFFALO, N. Y.—The Frontier Telephone Company has asked permission of the city to install public telephone on several street corners in this city.

BUFFALO, N. Y.—These directors, to serve for a year, have just been chosen at the annual meeting of the stockholders of the Frontier Telephone Company: William H. Andrews, Charles E. Austin, Martin Carey, Robert W. Chapin, William A. Douglas, Charles W. Goodyear, R. R. Hefford, Burt G. Hubbell, Clark L. Ingham, Andrew Langdon, F. C. M. Lautz, H. H. Littell, E. C. Lufkin, H. H. Persons, George A. Plimpton.

FARGO, N. D.—The Northwestern Telephone Company is stringing extra wires between Fargo and Jamestown. The new line will be used entirely on local business, leaving the old for through business.

JEFFERSONVILLE, OHIO.—The Bell and Citizens Telephone exchanges were recently destroyed by fire.

GUTHRIE, OKLA.—A mortgage has been filed by the Pioneer Telephone Company in favor of the Pioneer Trust Company for $750,000. It covers all lines and exchanges in both Oklahoma and Indian Territory, all of which are now owned by the Pioneer Company.

PIERRE, S. D.—J. L. W. Zietlow has purchased the lines and exchanges of the Capital City Telephone Company for the Dakota Central Company.

CHAMBERLAIN, S. D.—The Great Western Telephone Company, capital $25,000, has been incorporated by Warren Young, David Henry and Frank B. Rowe. A line will be extended to Presho.

HUNTINGDON, TENN.—The citizens of Newbill, in this county, have organized an independent telephone company. They will extend a line from Newbill to Huntingdon, connecting with the Cumberland Company. R. E. May is president of the new company, and J. A. Scates is secretary and treasurer.

DEL RIO, TEX.—T. H. Sharp and others, of San Angelo, have purchased the local telephone exchange of C. W. O'Dell. The consideration was $6,300.

LAREDO, TEX.—It is understood that the Rio Grande and Eagle Pass Railroad contemplates installing a telephone line from its depot in this city to its mines.

DALLAS, TEX.—The Texas Independent Telephone Clearing House Association has been organized in Dallas and application has been made to the Secretary of State for a charter. The purpose of the organization is to organize the independent long-distance telephone business under one head for the mutual benefit of all lines concerned.. The incorporators are E. W. Dunaway, Paris; A. J. Brown, Dallas; Cecil L. Simpson, Dallas; J. N. Earle, Waco; J. E. Boynton, Waco; G. R. Butler, Gainesville, and C. A. Shock, Sherman. There are 75 companies in the State which own about 10,000 miles of toll lines.

MADISON, WIS.—The City Council has ordered the Wisconsin Telephone Company to place its wires underground.

Electric Light and Power.

UKIAH, CAL.—The Supervisors have granted the Eel River Power & Irrigation Company a franchise for a transmission line from Potter Valley to Ukiah.

SAN FRANCISCO, CAL.—The Northern Water & Power Company has been formed by H. L. Atkinson, C. P. Pritchard, T. A. Allan and others; the capital is $5,000,000.

SANTA MARIA, CAL.—The Isaac Springer Investment Company, of Los Angeles, has purchased the Santa Maria Light & Power Company, and contemplates extending its lines to Guadalupe.

SAN FRANCISCO, CAL.—The General Electric Power Company, of San Francisco, has been incorporated with a capital stock of $1,000,000, by J. P. Lucey, W. E. Cashman, W. T. Love and K. J. C. Seymour and Guy C. Calden.

LOS ANGELES, CAL.—The Pacific Light & Power Company, of Los Angeles, is preparing to develop electric power in Yavapai County, Ariz. The initial installation will consist of a 1,200-h.p. hydro-electric plant, which it is expected to increase to 6,000 horse-power eventually.

SAN FRANCISCO, CAL.—The General Electric Company is equipping a sub-station plant in the United Railroad's power house at the intersection of Eleventh and Bryant streets, San Francisco. Five 1,100-kw step-down transformers will take current at 13,200 volts from the lines of the California Gas & Electric Corporation, reducing the voltage to 440 volts. Five 1,000-kw rotary converters will then supply direct current for the operation of cars. The present sub-stations will be retained in service after the new power contract goes into effect, January 1, 1906.

SAN FRANCISCO, CAL.—John Martin & Co. have sold two orders of 7-strand aluminum cables, aggregating 150,000 lbs., to the California Gas & Electric Corporation for use on its extensions. An additional 45-mile, 3-phase transmission line will be built between San Francisco and San Jose. Six-naught cable, of 350,000 circ. mills will be used. The other order, consisting of No. 1 aluminum, will be used on a new branch transmission line, tieing in near San Jose and extending 40 miles to the cement works of the Santa Cruz Portland Cement Company's new plant at Davenport, Santa Cruz County. Power will be supplied for the manufacture of about 5,000 barrels of cement per day.

GREELEY, COL.—The Home Electric Light & Power Company has increased its capital from $4,500 to $50,000, and will enlarge its plant and supply the entire town. Professor Hayes, vice-president of the State Normal School, is an officer of the company.

NORWICH, CONN.—An electric plant is to be installed at the Kingsbury box and printing company's factory for lighting purposes.

NEW BRITAIN, CONN.—The H. B. Olmstead Company has put a fine electric plant in its factory. A new 50-hp. upright Westinghouse engine is being installed. This engine will operate a 400-light dynamo and supply power in certain departments when the main steam engine is not running.

COLUMBUS, GA.—A committee has been appointed to investigate the cost of a municipal electric lighting plant for this place.

OCILLA, GA.—The Mayor and Board of Aldermen have awarded to Engineer J. B. McCrary of Senoia, the contract for an electric light plant and water works system, to cost about $28,000.

CICERO, IND.—The Sanborn-Marsh Electric Company, of Indianapolis, has secured the contract for constructing an electric light plant here.

VINITA, IND. TER.—The plant of the Vinita Electric Light, Ice & Power Company was destroyed by fire Sept. 26.

MUSKOGEE, IND. TER.—G. W. Sargent, of Joplin, Mo., has asked for permission to construct a power plant to replace the one recently destroyed by fire.

CHICAGO, ILL.—John H. Radford is preparing plans for an addition to the electric light plant, at 58th St. and Cottage Grove Ave., Washington Park, for the South Park Commissioners.

QUINCY, ILL.—The Royal Trust Company, of Chicago, filed a foreclosure suit Sept. 28 against the Independent Light & Power Company, of Quincy. Edwin B. Hillman was appointed trustee. In 1904 the company issued 175 mortgage bonds of $1,000 each, drawing 5 per cent. interest. It is said that the interest has not been paid on these bonds, and the aggregate claims of the trust company are $183,993. It is expected that the Quincy Gas, Heating & Lighting Company will buy the stock.

WILLIAMSBURG, KY.—Gleaves & Co., of Lynchburg, Va., propose to construct and own water works and an electric light plant at Williamsburg, to cost about $45,000. J. A. Gillman is the engineer.

EASTPORT, ME.—The Copen Light & Power Company has been organized at Eastport, for the purpose of generating and supplying gas and electricity for lighting, heating and mechanical purposes in Perry, Pembroke and Dennysville, in Washington county, Maine, with $10,000 capital stock. The officers are: President, Chas. E. Copen, of Eastport; treasurer, Chas. H. Emery of Eastport.

BUCKSPORT, ME.—There are rumored plans for the development of an electric power plant at Orland upper falls. Recently an expert has been making estimates of the extent of the power, the storage of water, the size of the watershed, the annual rainfall, etc., and the result of these will no doubt warrant the expenditure of many thousands of dollars, in the construction of dams, acquirement of flowage rights, purchase of real estate, besides the construction of buildings, installation of machinery, etc.

MEDWAY, MASS.—The Kendall Construction Company, of Boston, has been awarded the contract by the Medway Electric Light & Power Company, to entirely reconstruct its street and commercial lighting systems in this city.

MONROE, MICH.—The Board of Public Works has authorized City Engineer J. W. White to investigate the water power in River Raisin, with a view to damming the stream at Dubois farm or Sisters Island, for use in the operation of the electric light plant.

VIRGINIA, MINN.—The Council has voted to extend the arc lighting system.

ST. LOUIS, MO.—The written acceptance by the General Service & Development Company of the terms imposed in its franchise recently granted by the county, has been filed. This company owns an electric plant at Brentwood and recently purchased the electric plant and contracts of the West St. Louis Water & Light Company, which is supplying a part of St. Louis County.

RAVENNA, NEB.—The Village Trustees are considering the question of constructing an electric light plant.

HASTINGS, NEB.—The municipal electric light and power plant is being enlarged by the addition of a 400-hp engine and generator, costing between $15,000 and $20,000.

AUBURN, N. Y.—The Auburn Gas Company has decided to purchase the plant and franchise of the Citizens' Light & Power Company, of Auburn.

PHOENIX, N. Y.—The Phoenix Fuel, Light & Water Company has been granted permission by the State Commission of Gas and Electricity to issue $100,000 bonds.

ROCHESTER, N. Y.—The Board of Supervisors has authorized the Building Commission to procure an estimate of cost of an electric lighting plant for the court house.

HERMON, N. Y.—The State Commission of Gas and Electricity has granted the application of the Hermon Electric Light Company, to transact business and issue $15,000 of stock.

AMSTERDAM, N. Y.—It is stated that the minority stockholders of The Magneto Electric Company have voted to accept the proposition of The Globe Electric Controller Company to merge the two companies by pooling the minority stock. The plan of The Globe Company is to capitalize a company at $250,000.

UTICA, N. Y.—The Hudson River Electric Power Company contemplates the construction of a 60,000-volt transmission line from Ballston to Utica. This line is now being surveyed and construction will begin in about 30 days. Steel towers will be used, spaced about 550 ft. apart. The company expects to purchase the towers, but will itself erect them and put up the conductors.

CHARLOTTE, N. C.—The Southern Power Company has recently had representatives in Spartanburg and Columbia, S. C., in each of which towns it is desired to bring 10,000 horse-power of electrical energy when the new developments are finished. About the same amount is now being used about Charlotte.

FOSTORIA, OHIO.—A committee has been appointed by the Board of Trade to look into the matter of establishing a municipal electric light plant. The present electric lighting contract with the city expires in August next.

GALION, OHIO.—According to the statement just issued by the service department, the cost of maintaining and operating the street arc lamps of this city by the municipal plant is but $27 a light per year. Much of the actual cost is paid from the earnings of the commercial department of the plant, leaving but a small balance to be paid by the taxpayers.

CLEVELAND, OHIO.—The Bradley Electric Light, Heating & Power Company has applied for a franchise for the use of the streets and other public parts of the city for the purpose of laying its wires. Under the State law the council must submit the matter to a vote of the people before any action can be taken. The company proposes to generate all the power in one central station and distribute it throughout the city through substations.

BAKER CITY, ORE.—The Fremont Power Company, of which John Waterman, John T. Thomson, Sumpter, Oregon, and Walter Fernald are the incorporators (capital, $200,000) will build the Olive Lake power plant near the Red Boy mine immediately.

PHILADELPHIA, PA.—The Philadelphia Electric Company has secured the electric lighting contract in this city during 1906 for a total of $1,073,271.

WILKES-BARRE, PA.—The Wilkes-Barre Gas & Electric Company is to equip its battery of six 225-h.p. boilers with a forced draft apparatus installed by the B. F. Sturtevant Company, of Boston, Mass.

PHILADELPHIA, PA.—It has been decided to award the contract for thte city's lighting for 1906 to the Philadelphia Electric Company. This corporation, which has the contract for this year, was the only bidder. Its offer was $1,070,000 or $118,000 less than what the city pays for 1905.

HAZELTON, PA.—This city was in darkness on the night of Oct. 6 as a result of a strike of the electric workers. The streets being in total darkness, few people ventured out at night. The policemen carried dark lanterns, which they attached to their belts, and thus equipped they escorted timid people to their homes.

HUNTINGDON, PA.—The Juniata Hydro-Electric Company, of Philadelphia, has commenced work on the development of an extensive water power on the Juniata River, near Huntingdon. A concrete-steel dam about 600 ft. long is now under construction, to be followed by a canal and power house. The contractors on the work are the Ambursen Hydraulic Construction Company, of Boston, Mass.

NEWPORT, R. I.—The council committee on street lighting has been authorized to ask for bids for the erection and installation of a municipal electric lighting plant.

GAFFNEY, S. C.—A party of surveyors recently visited Broad River, near Gaffney, in behalf of capitalists who may bring about extensive electrical development.

SALT LAKE CITY, UTAH.—The Inter-Mountain Power Company is preparing to build a system of hydro-electric plants near Salt Lake City, with steam auxiliary. The capacity will be 5,000 horse power. Plans and specifications are in course of preparation by Frank C. Kelsey, Salt Lake City.

AMERICAN FORK, UTAH.—It is understood here that J. H. Bigger and J. E. Hill, of Salt Lake City, expect to develop 950 horse-power for electric lighting and propelling machinery in the American Fork mining district. An application has been filled with State Engineer Caleb Tanner, asking for 22 ft. of water to be taken from the American Fork Creek. The proposed diverting works will consist of a dam, spillway, headgate and pipe line, about 4,000 feet long.

OGDEN, UTAH.—E. W. Wade has been looking into a proposition relative to the construction of a power plant on the river 17 miles out of Blackfoot, Idaho. Christian Just, of Blackfoot, and others are interested in the project. Mr. Wade states that by the construction of a canal about 1,500 feet long a power plant could be established without building a dam and 1,000 horse-power developed. The power could be increased by erecting a dam. The plan is to furnish light and power to Idaho Falls and Blackfoot. The cost of the project is estimated at $100,000.

ASHLAND, VA.—The Virginia Light & Power Company, recently incorporated, proposes to furnish a light and power service. No engineer has been appointed yet and no bids have been asked for.

MONTPELIER, VT.—The Consolidated Lighting Company of Montpelier, has increased its capital stock from $350,000 to $1,000,000. The increase was voted last May, when the plant changed owners.

TACOMA, WASH.—The Nisqually Power Company has been incorporated by R. L. McCormick, Edw. Cookingham and others, to construct a power plant near the Tacoma Eastern R. R. below Eatonville.

SPOKANE, WASH.—The Big Bend Water Power Company has been organized by J. H. Tilsey, John E. Peterson, Reuben Cross and others, to develop 15,000 horse-power about 28 miles down the river. E. Tappan Tannant is the engineer.

SEATTLE, WASH.—The demand for light and power for commercial purposes has been so heavy that City Engineer Thomson and Superintendent L. B. Youngs, of the water and light department, will soon make arrangements for increasing the municipal lighting plant by installing another hydro-electric unit at a cost of $15,000. There are now two units with a capacity of about 3,500 horse-power and with the third one, the capacity will be increased to 5,000 horse-power.

MARTINSVILLE, W. VA.—The citizens voted on Sept. 28 to issue $12,000 bonds to complete the electric light and power plant. J. R. Gregory is the city engineer.

PORT WASHINGTON, WIS.—No engineer has as yet been engaged for the proposed water works and electric light plant. The probable cost of construction is $75,000. W. A. Tholen is city clerk.

GUANAJUATO, MEX.—The Peregrina Mining Company, operating in Guanajuato, intends to erect a cyanide plant with a capacity of 250 tons, to be operated by electric power.

CITY OF MEXICO, MEX.—George G. Bergman, of the City of Mexico, has applied for a concession to develop water power and build an electric plant on the River Blanco, near Vera Cruz.

CITY OF MEXICO, MEX.—Vicente Martinez, of the City of Mexico, will build an electric plant for the transmission of electric power at Xicotlacotia between the states of Morelos and Guerrero.

CITY OF MEXICO, MEX.—Pedro Alvarado, the wealthy Mexican mine owner, has awarded to Weisel & Kock, of Parral, Chihuahua, the contract for installing a new electric power plant at his Palmullio mines. Boilers are to be of the high-pressure type; engine, of the standard Corliss make, compound-tandem, with direct-connected 700-k.w. alternating-current, 2200-volt generators and exciter. Weisel & Kock are in the market for electrical supplies.

OTTAWA, ONT.—The Dominion government has passed an order granting permission for the construction of a dam across the Rainy River at Fort Francis. This proposal has been before the government for a long time, and electrical interests have been urging for the power to make the improvement.

OTTAWA, ONT.—The Ottawa Electric Company, in order to prevent all possibility of impaired service owing to the carrying out of works of improvement, shortage of water, anchor ice, etc., has decided to install a steam reserve plant of considerable capacity, in addition to the steam plant already owned and operated by this company as an emergency plant. The new installation will consist of a Westinghouse-Parsons steam turbine direct connected to a 2-phase 1,500-kw alternating-current generator. The exciter will be mounted on a bracket and on the turbine frame, and direct connected to the turbine shaft, and there will be other sources of current for exciting the field, which will be available at any time in case of failure of the exciter. The boiler capacity will be sufficient to operate the turbine and generator to the highest limit allowable for overload when desired.

MONTREAL, QUE.—The equipment of the power plant of the Kaministiquia Power Company, now being erected at Kakabeka Falls, near Fort William, Ont., will be the best that can be secured. A part of it has been contracted for in Germany, while the motors, transformers and other equipment will be supplied by the Canadian General Electric Company. The actual water head is 181 feet high, which is considerably higher than at Niagara Falls. It is the intention of the company to generate 30,000 horse power, the first installation on which work is now being rushed, being 10,000 horse power. The company expects to deliver power into Fort William about June 1 next, and the indications are that the entire amount of power that will be available will be readily disposed of. In addition to contracts with the Ogilvie Flour Mills Company, which will take 1,000 horse power, and the town of Fort William, power will be sold to the Canadian Pacific and Grand Trunk railways. A large American industrial company will also take power from the company.

The Electric Railway.

SAN FRANCISCO, CAL.—The Vallejo, Benicia & Napa Valley Electric Railway has been sold to Boston capitalists.

STOCKTON, CAL.—A third electric railway may be built in Stockton, and if it is constructed it will be part of another interurban system, which will extend to the Yosemite Valley. A. C. James is interested.

STOCKTON, CAL.—An electric railway is to be built to the Yosemite Valley from Stockton, and will be financially backed by Keene and Van Cortland of New York. All the franchises have been secured and the road will be run to Gentry.

SAN FRANCISCO, CAL.—Cory, Meredith & Allen, of San Francisco, have been retained as consulting engineers for the Pueblo Suburban Traction & Light Company, of Pueblo, Col. Mr. Wynn Meredith has left for Pueblo and will be there about two weeks getting data and details preparatory to making additions and modifications of the company's present rather extensive hydro-electric transmission system. The company's plant is located on Beaver Creek and power is transmitted to Victor and Pueblo.

SAN FRANCISCO, CAL.—The Sacramento & Lake Tahoe Railway Company has been incorporated to operate a road from Sacramento to a point on the southern shore of Lake Tahoe. The line will be about 125 miles long, and a branch line of about 40 miles in length will connect the main line with Newcastle and Auburn. Three other branches are also projected. The company is capitalized at $7,500,000 and the incorporators are B. G. Raybould, W. S. Graham, Auburn; Leo Alexander, Thomas H. Nicholls, James H. Swift, T. Otway Sadlier, Edward F. Haas, John A. Black and Charles Wesley Reed.

WILLIMANTIC, CONN.—The Willimantic Traction Company's property has been transferred to the Consolidated Street Railway Company, the holding company of the New Haven's Connecticut trolley lines.

ATHENS, GA.—The Athens Electric Railway Company is erecting a turbine station, the initial capacity of which will be one 500-k.w. unit. The plant is designed for a capacity of 4 machines.

AUGUSTA, GA.—The Augusta-Aiken Railway & Electric Company, and its allied corporations, have elected officers as follows: President, John Blair McAfee; vice-president, H. H. Cumming; secretary and treasurer, A. J. McKnight; general counsel, W. H. Barrett; general manager, R. E. Hunt.

BOISE, IDAHO.—Articles of incorporation of the Boise Valley Railway Company, Limited, have been filed with the Secretary of State, the capitalization being $1,000,000. The intention of the company is to build an electric railway from this city to Caldwell, a distance of 30 miles, and a branch road to the plant of the Barber Lumber Company, six miles from this city. The directors of the incorporation are: B. F. Olden, John McMillan, Robert Noble, A. Ross, H. E. Neal, D. R. Hubbard, W. N. Donaldson, O. V. Allen and H. P. Ustick..

BOISE, IDAHO.—The Roberts & Abbott Company, of Cleveland, is doing the preliminary engineering work on the Boise Interurban Railway Company's project. It contemplates building a line from Boise City to Caldwell, a distance of 30 miles from another line from Boise City to Nampa, a distance of 38 miles. Surveys are also being made for a 14-mile spur line to Pearl, an important mining town. The project also contemplates the development of a water power of about 9,000 horse-power, located about 50 miles from Boise.

CHICAGO, ILL.—A definite proposition for a new franchise grant to the Chicago City Railway Company and the Chicago Union Traction Company has been made by the companies to the Chicago City Council. The offer is equivalent to $30,000,000 or $35,000,000 cash to the city, and provides for the termination of all rights under the ninety-nine year act and ordinances at the expiration of twenty years.

CHICAGO, ILL.—The Chicago City Railway has submitted terms on which it asks a twenty-year franchise. The company agrees: To interchange transfers and route through cars over Union Traction lines; to rehabilitate lines with new cars and grooved rails, and to furnish service as required by City Council; to accept twenty-year franchise in lieu of all present rights and let the city purchase after a stated time; to change all cable lines to trolley power, using underground trolley in State Street and downtown if desired; to sweep and sprinkle streets occupied by its lines; to fill, grade, pave, and repair sixteen feet of street occupied by its lines; to make public reports of its earnings; to pay compensation on percentage basis, increasing with length of grant, charging 5 cents fare.

NOBLESVILLE, IND.—The Indianapolis, Hartford City & Eastern Traction Company has asked for a franchise in this city.

FORT WAYNE, IND.—Through service from Fort Wayne to Lima, Ohio, was inaugurated on Sept. 29 over the Fort Wayne, Van Wert & Lima line.

INDIANAPOLIS, IND.—The Indianapolis, Columbus & Southern Traction Company next year will build an extension to Seymour, Ind., 18 miles distant.

NEW ALBANY, IND.—R. W. White, John F. Stratton, C. D. Kelso and others have organized and incorporated an interurban express company. The capital stock is $10,000. It is the purpose of the company to deliver expressage, packages, parcels, etc. It will operate exclusively over the interurban roads.

BLUFFTON, IND.—A company has been formed in this city to finance and construct the Marion, Bluffton & Eastern Interurban Railway from Marion to Bluffton. The company is capitalized at $500,000, and is said to have a friendly understanding with the Fort Wayne & Wabash Valley Company. L. C. Davenport, of Bluffton, is president, and W. A. Kunkel, secretary and treasurer.

INDIANAPOLIS, IND.—The Louisville & Indianapolis Traction Company has filed articles of incorporation. The capital stock is $10,000. J. R. Schindel is president and Samuel Adams, secretary. It is the purpose of the company to build an electric railway between Louisville and Indianapolis, paralleling the Pennsylvania to Columbus, Ind., where the cars will be operated over the tracks of the Indianapolis, Columbus & Southern Indiana Traction Company.

INDIANAPOLIS, IND.—The Wabash & Northern Traction Company has filed articles of incorporation with the Secretary of State. The capital stock is $500,000, which is to be increased to $800,000. The road will be a part of the Indiana Northern Traction Company, but will be distinct for the purpose of issuing bonds. The company will in addition to building and operating a line from Wabash to Warsaw furnish light, heat and power to a score of towns and cities along the line. James A. Barry, Lincoln Gynn and others are directors. The company's headquarters will be in Wabash.

HOPKINSVILLE, KY.—A 20-year franchise for an electric street railway has been sold to John H. Bell, Jr., of Hopkinsville.

FREDERICK, MD.—The sale of the Frederick & Middletown Electric Railroad has been formally consummated. The company organized by electing officers as follows: President, James E. Ingram, Jr., Baltimore; vice-president, J. Roger McSherry, Frederick; secretary, Emory L. Coblentz, Middletown; treasurer, Thomas H. Haller, Frederick. The new management says it will make extensive betterments to the road.

WARE, MASS.—The Hampshire & Worcester Street Railway has been sold at auction to C. G. Schulte, representing the American Trust Company of Boston, for $5,000 over and above all incumbrances. The road was sold for non-payment of taxes.

MARSHALL, MO.—Ernest D. Martin and associates are promoting an electric railway to extend from Marshall to Sedalia, and from Marshall to Miami, a distance of 50 miles.

ST. LOUIS, MO.—A charter has been issued to the St. Louis, Lakewood & Grant Park Railway, of St. Louis, which has a capital of $300,000. F. M. Estes, L. H. Conn, H. H. Waters and others are the directors.

TRENTON, N. J.—The Rio de Janeiro Tramway, Light & Power Company recently incorporated under the laws of New Jersey, has filed a certificate changing its name to the Villa Isabel Tramway Company.

ROME, N. Y.—The Rome and Oneida Electric Railway has been incorporated; capital, $350,000. Directors: Dr. T. L. Hill, C. C. Goodwin, New York; E. F. Lally and G. V. Lally, Detroit.

CHARLOTTE, N. C.—The Southern Power Company, Charlotte, will build a 60-mile railway from the Great Fall development on Catawba River to Harmony, S. C., for the use and convenience of the company.

ZANESVILLE, OHIO.—The Zanesville Railway, Light & Power Company will extend its Brighton Street line to manufacturing plants east of the city.

MARION, OHIO.—The Marion-Bucyrus Railway & Light Company has organized with the following officers: President, E. A. Bartholomew, Toledo; vice-president, J. W. Morrill, San Francisco; secretary, R. S. Giles, Cleveland; treasurer, S. M. Finch, Lima.

CINCINNATI, O.—Citizens of Sharonville, Reading and Avondale, small surburban villages near this city, are working on a project to build an electric railway to connect with the Cincinnati city system. Among those back of the enterprise are Charles Cooper, A. Heineman and S. Browne, of Reading, and Charles Komar, of Sharonville.

CLEVELAND, OHIO.—The Cleveland Electric Railway has filed an amended bill in the U. S. Circuit Court against the city and the Forest City Railway Company asking the court to enjoin the city and the 3-cent fare company from taking possession of the company's Central Avenue line, on which the city claims the grant has expired.

ATHENS, OHIO.—The Nelsonville, Athens & Glouster Traction Company has been incorporated with $10,000 capital stock by J. P. Reynolds, L. E. Carpenter, F. E. Wells, W. J. Stuart, B. C. Wise, Charles Tutt and others.

LIMA, OHIO.—The Lima Electric Railway & Light Company has increased its capital stock from $850,000 to $1,250,000. The company is planning important improvements.

DOYLESTOWN, PA.—A bill in equity has been filed asking that receivers be appointed for the Philadelphia & Eastern Railway Company. The plaintiffs in the suit are William H. Kreider and Thomas Raeburn White, receivers for H. M. Herbert & Co., who constructed the electric line. The road is 36 miles long, and extends from here to Boston. It cost more than $1,000,000.

ANDERSON, S. C.—The incorporators of the Anderson-Easley Electric Interurban Railway have applied to the State for a charter. The company will have $100,000 capital. The incorporators are: R. Frank Smith, of Easley; J. J. Fretwell, of Anderson, and others.

NASHVILLE, TENN.—It is announced that negotiations have been concluded in New York for financing the Nashville & Franklin Interurban Electric Railway. The same New York financiers are considering advancing money to build the line to Mt. Pleasant further south, and also from Gallatin to Nashville. These will be the first interurban lines in Tennessee.

LYNCHBURG, VA.—The new power house of the Lynchburg Traction and Light Company, on the James River, three miles above this city, is now in operation. It has a present capacity of 4,500 horse-power. The plant cost upward of $150,000.

HAMPTON, VA.—The Hampton Roads Railway and Electric Company, of Hampton, was sold at auction on Oct. 6, to Horace A. Doan, who was the representative from Philadelphia of the protective committee of bondholders of that city, the price being $250,000.

OLYMPIA, WASH.—The company which proposes to build a new electric railway between Puyallup and Tacoma has recently filed articles of incorporation under the name of the Puyallup Valley Traction Company. It will have its principal office in Tacoma. The capital stock is placed at $250,000, and the trustees are named as follows: Fred J. Chamberlain, W. D. Cotter, W. H. Elvins, J. E. Stevenson, M. L. Brooks, John Mills, W. R. Scott, L. A. Chamberlain and Charles Tullmer.

FAIRMONT, W. VA.—T. J. Conway, C. E. Conway, of this city, A. B. Overholt, Pittsburg; C. W. Dillinger, Baltimore, and B. W. Overholt, Wooster, will ask for a charter for the Fairmont & Fairview Street Railway Company. It is proposed to build the line from Fairmont to Fairview next spring, at a cost of half a million dollars, and as soon as that portion of the road is completed to go ahead with the building of the line as far as Wheeling.

WHEELING, W. VA.—The Steubenville & Wheeling Traction Company, the subsidiary of the Wheeling Traction Company, recently acquired by deed from the Steubenville, Mingo & Ohio Valley Traction Company all the rights, property and franchises of that company pertaining to the 9-mile line from Steubenville to Brilliant, O., subject presumably to the $150,000 mortgage of 1900. The Belmont County Commissioners have granted a franchise for the extension southward to Martin's Ferry on the condition that the road shall be in operation by Sept. 1, 1907.

BARABOO, WIS.—A committee of the City Council, of which Mayor E. G. Marriott is chairman, has been appointed to confer with N. Wetzel, president of the Dells Company, of Kilbourn, with a view of connecting the Dells of Wisconsin and Devil's Lake with an electric railway. The road, for which the right of way has already been secured, will cost about $50,000.

VANCOUVER, B. C.—It is announced that the British Columbia Electric Railway Company will further increase the capacity of its plant at Lake Beautiful and construct another pipe line from the dam to the power house.

ST. JOSEPH, ONT.—The St. Joseph & Stratford Electric Railway Company has been organized to build an electric railway from St. Joseph to Stratford, a distance of 39 miles. The officers of the company are: N. M. Cantin, of St. Joseph, vice-president and manager; O. Bissonnett, St. Joseph, secretary; Thos. T. Tombyll, treasurer.

New Industrial Companies.

THE SOUTH SIDE ELECTRIC MANUFACTURING COMPANY, of Pittsburg, has been formed and is capitalized at $65,000, to operate a light and power plant.

THE INTERURBAN ELECTRIC EQUIPMENT COMPANY has been formed in Brooklyn, N. Y., with a captital of $4,000. Directors: W. C. Bunn, Thomas Pitt, Brooklyn; C. T. Staines, Newark.

THE H. G. POPE ELECTRIC AND MANUFACTURING COMPANY, of Buffalo, has been incorporated with a capital of $200,000. The directors are H. G. Pope, Ida B. Pope, William A. Peters, New York.

THE COOPER ELECTRIC SAFETY GATE COMPANY has been incorporated in Delaware to manufacture electrical devices, signals and automatic appliances. The capital stock is $150,000, the incorporators being Philadelphians.

THE ARMSTRONG AUDIBLE TELEGRAPH INSTRUCTION COMPANY has been incorporated at St. Louis, Mo., with a capital stock of $40,000. The object of the corporation is to manufacture and deal in mechanical Martin Armstrong, John R. Dwyer, Lewis P. Delani and Hans Wulff, all of and electrical appliances pertaining to telegraphy. The incorporators are: St. Louis, and Claude Wetmore, of Kirkwood, Mo.

AMSTERDAM CORPORATION.—The Amsterdam Corporation of New Haven has filed a certificate of incorporation. The authorized capital is $10,000. The charter allows the company the broad powers occasionally asked asked for by companies of this kind, and includes the right to manufacture and produce electricity, construct and operate works for the accumulation and distribution of electricity for light, heat, power and signaling, construct bridges, buildings, ships, machinery, railroads, tunnels, subways, docks and canals. The incorporators are Louis B. Grant, Ashley T. Cole and William J. Bagnell.

Personal.

MR. J. R. SHIELDS will have charge of an electrical course forming part of the winter programme of evening instruction of the West Side Young Men's Christian Association of New York.

MR. K. B. THORNTON, operating manager of J. G. White & Company, has been appointed manager of the Nassau Light & Power Company, at Roslyn, Long Island. This company is managed and operated by J. G. White & Company.

MR. G. A. NISBET for several years sales agent for the General Incandescent Arc Light Company, and latterly of the Stanley-G.I. Electric Manufacturing Company, has accepted the position of general manager of the Chas. A. Thompson Company, New York. Mr. Nisbet has an extensive acquaintance in the electrical field.

MR. G. F. BROCKMAN, electrical engineer and superintendent of the Hydro Electric Light & Steam Power Company, of Jackson, Ala., has resigned. He was the designer and builder of this installation, about 18 months ago, and has operated it for 14 months, every night, without a shut down of a second, for any cause. Mr. Brockman is visiting Catherine, Ala., Louisville, Ky., and Rockford, Ill.

MR. T. K. WELLS has jointed the staff of J. G. White & Company, of New York, and will proceed to the Philippine Islands to take up the duties of superintendent of transportation for the Manila Electric Railway & Lighting Company. Mr. Wells was with the Wabash Railroad and the St. Louis, Iron Mountain & Southern Railroad for 14 years, following which he spent eight years with the Syracuse Rapid Transit Company.

MR. C. L. SEEGER.—The Electric Storage Battery Company, of Philadelphia, is now represented in Mexico by Mr. Charles L. Seeger, whose office is located at Primera de Humboldt No. 10, Mexico City. Mr. W. G. Davis, who has for some time been connected with the Electric Storage Battery Company in their Pennsylvania sales office, is now associated with Mr. Seeger in the Mexican office, and his thorough familiarity with storage battery practice enables him to take up all engineering matters in this special field of electrical work.

MR. B. J. JONES has recently become manager of the electrical department of the Cincinnati Gas & Electric Company. Mr. Jones is well known in Chicago electrical circles, having been since 1897 on the staff of Sargent & Lundy, consulting engineers. His first work with that company was that of the direct supervision of the electrical equipment of the South Side Elevated Railroad. He has been prominently identified with a number of the important jobs taken by that firm, and in this connection has come closely in touch with the electrical work of the Cincinnati Gas & Electric Company. He is the inventor of the flat flexible bond and solid terminal, designed to go under the firsh plate, which was sold originally as the Atkinson bond, being made by that company. He is also the designer of many of the details of high-tension construction used on the Indianapolis & Cincinnati Traction Company's line between Indianapolis and Rushville, and adopted by the Westinghouse Electric & Manufacturing Company as standard construction for certain classes of single-phase trolley work.. Previous to his connection with Sargent & Lundy, Mr. Jones was superintendent of the South Chicago City Railway Company, which position he accepted upon leaving a similar position at Sioux City, Iowa. He was at one time with the Westinghouse Electric & Manufacturing Company.

Trade Publications.

A. L. IDE & SONS, Springfield, Ill., have issued a very neat "Ideal Reminder" filled with memo pads, perforated for ready detachment. The covers are illustrated with views of Ide engines.

INSULATORS.—An interesting and reliable publication on insulation has just been received from the Locke Insulator Manufacturing Company, Victor, N. Y., in the form of a supplement to its "Insulator Book." It is the intention of the company that parties now possessing copies of the "Insulator Book" shall obtain the "Supplement," so as to bring the treatise up to date.

EXAMINATION OF FUEL.—Walter & Renaud, 159 Front Street, New York, has published in pamphlet form an article on "The Commercial Examination of Fuel," which just appeared in *The Black Diamond*. The article describes, in detail, the processes involved in determining the available heat units in various samples of fuel, as applied by this company in its New York laboratory.

SILVER POLISHING BY ELECTRICITY.—Johnson Livingston, Jr., & Company, 113 East Twenty-second Street, New York, have issued an illustrated booklet dealing with electrically-driven polishers for silver, gold and bright metal ware. The motors are of the bipolar single-field-coil type. Each motor is supplied with the necessary cleaning and buffing wheels, including one four-inch and one eight-inch muslin buff, and one three-inch bristle brush.

INDUSTRIAL ENGINEERING.—An interesting illustrated pamphlet has recently been issued by the Industrial Engineering Company of America, 32 Broadway, New York. There are shown various plants, machines and tools in order to give an idea of the character of the work done by the company. Views are given of electric motors, turret lathes, tool grinders, and saw-tooth roofs for machine shops.. The designs for all of these were prepared by the company.

HARDWARE.—Catalogue No. 18 of the Yale & Towne Mfg. Company, which has for its title "Locks and Hardware,' contains over 200 octavo pages and is neatly bound in green board covers with red cloth back and gold lettering. In addition to cataloguing padlocks, night latches, builders' hardware, door checks, etc., it contains a comprehensive glossary of technical terms and notes of interest on the mechanism and care of locks, lock-picking, master-keyed locks, hand and bevel of doors, etc.

SUCTION GAS PRODUCERS.—Oskar Nagel, 90 Wall Street, New York, has recently issued an illustrated catalogue dealing with suction gas producers. In this system air is drawn by the sucking action of the engine over hot water or steam, and then the air, saturated with steam, goes through the fuel bed, being converted thereby into power gas, which, after suitable purification, goes to the engine. It is stated that from 1 to 1.25 lbs. of anthracite or 1.3 to 1.5 lbs. of coke is sufficient for 1 hp-hour, and that a horse-power for 24 hours will cost from 6 to 8 cents.

ELECTRIC LOCOMOTIVES.—The General Electric Company, Schenectady, N. Y., has issued as bulletin No. 9139 a treatise on "Electricity versus Steam for Train Haulage," which consists of an article by L. R. Pomeroy, on "The Electrification of Trunk Lines" and a paper by W. B. Potter on "Developments in Electric Traction," which was read before the New York Railroad Club Jan. 20, 1905. The bulletin is well illustrated, numerous views being given of electric locomotives for railroad work, notably the B. & O. and the N. Y. C. & H. R. locomotives.

STORAGE BATTERIES.—The Dayton Manufacturing Company, Dayton, O., has published an illustrated bulletin, numbered 131, giving detailed information relative to isolated lighting plants. In the Silvey type B cell, the plates, which are of the pasted type, are piled one on top of another, with two sheets of absorbent separating material between the adjacent plates. Since the elements lie horizontal, it is practically impossible for the active material to fall from the plates, and the cells do not become short-circuited. In the type SB cell, a positive and a negative plate are joined to one common connector, and are suspended in glass jars. The hard lead grid has a large number of small pockets in which the active material is placed and allowed to harden. Over the whole plate is placed a perforated sheet lead cover so that it is practically impossible for the active material to be forced from the grid.

THE INTERNATIONAL INSTRUMENT COMPANY, Cambridge, Mass., is distributing a desk blotter on which is printed a list of some of the apparatus manufactured by it. The list includes electrolytic apparatus, laboratory switchboards, voltmeters and ammeters, rheostats, physics apparatus, cement tester, etc.

THE COMMERCIAL AUTOMOBILE COMPANY, 1336 Michigan Avenue, Chicago, has issued a circular of the Synnestvedt electric vehicles, which are designed for commercial purposes. Some excellent illustrations show light and heavy delivery wagons, also a plan view of the chassis used on these vehicles.

ARC LAMPS.—The American Arc Lamp Company, Kalamazoo, Mich., has issued an attractive catalogue illustrating and describing its new line of direct-current arc lamps, which are characterized by great simplicity of construction, thereby enabling users to make their own repairs and practically rebuild the lamp when required.

INTERCOMMUNICATING TELEPHONES.—The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., has issued bulletin No. 13, dealing with intercommunicating telephones. This system has been devised especially for the rapid transaction of business between the various departments of a single concern. Each telephone can be equipped with exchange connections, making it possible to carry on conversation with outside parties. The bulletin is an exceptionally neat publication, and is well illustrated. Diagrams are given to show the methods by which the various telephones are connected in circuit.

News of the Trade.

BRASS SHELL SOCKETS.—Pass & Seymour, owing to the demand for its new line of double-pole brass shell sockets, have had to increase the output capacity of this department.

THE SUN PORCELAIN COMPANY, Trenton, N. J., reports a very encouraging business for the short time it has been operating. It has found it necessary to open a New York office at 39 Cortlandt Street, to take care of the increasing business in New York and vicinity.

THE APPETON ELECTRIC COMPANY, Chicago, Ill., has opened a New York branch at 227 Fulton Street, where it will carry a full stock of fuse wire and strip fuse links, lock nuts, bushings, etc. This office will be under the management of Mr. A. S. Merrill, who has a large acquaintance in the electrical field.

THE BARRIETT ELECTRIC MANUFACTURING COMPANY announces that Walter Macleod & Co., of Cincinnati and New York, have been appointed sole selling agents for motors and dynamos in connection with railroads in the United States. The Philadelphia Electric Construction Company, of Philadelphia are selling agents for Philadelphia.

THE KILBOURNE-CLARK COMPANY, of San Francisco and Seattle, has moved to a handsome suite of offices at 106-108 Rialto Building, San Francisco, Cal., occupying the ground and mezzanine floors. H. G. Aylsworth is manager and E. B. Parsons has charge of machinery sales. The Coast agency of the National Electric Company is carried by this firm.

THE NATIONAL X-RAY REFLECTOR COMPANY, recently at 185 Van Buren Street, Chicago, has moved to new and larger quarters at 126 Franklin Street. Among the newer specialties of this company is a line of concave and convex ceiling rosettes, 7-in. and 10-in. corrugated cones, two ornamental shades and a 14-in. sectional and adjustable corrugated silver-plated glass trough reflector for store windows and picture lighting. Mr. A. D. Curtis has recently purchased a controlling interest in this company.

THE LOCKE INSULATOR MANUFACTURING COMPANY, Victor, N. Y., has broken ground for an addition to its present works, which will include eight modern kilns specially designed for insulator work, which will be constructed entirely of reinforced concrete. This plant will be 180 feet square, two stories high, and will include the most modern methods of handling clay, coal, etc. The company states that with the additions which have been made during the past year, this later increase will make its works the largest in the world devoted exclusively to the production of insulators.

THE ELECTRICAL SHOW.—The managers of the Madison Square Garden Electrical Show are meeting with very gratifying and substantial cooperation from the electrical industry. Since the announcement of the broad-guage plans which have been developed for insuring a great popular success at the Garden next December a great many new contracts for space have been received. Among others the following well known firms have selected their space and are busy preparing attractive exhibits: National Carbon Company, Harry M. Stevens, Eastern Carbon Works, Joseph Goldfinger, New York Telephone Company, Chicago Pneumatic Tool Company, Electro-Dynamic Company, General Storage Battery Company, G. M. Gest, Ovington Manufacturing Company.

CONCRETE BLOCKS.—The prizes offered by "Engineering News" and the "Cement Age" of New York for the best papers on "The Manufacture of Concrete Blocks and Their Use in Building Construction," have just been awarded by the jury, which was composed of Messrs. Robert W. Lesley, past president of the American Cement Manufacturers' Association; Richard L. Humphrey, president of the Cement Users' Association; and Prof. Edgar Marburg, secretary of the American Society of Testing Materials. The first prize of $250 was won by a paper by Mr. H. H. Rice, of Denver, Col., secretary of the American Hydraulic Stone Company. The second prize of $100 is given to a paper by Mr. Wm. M. Torrance, C. E., of New York City, assistant engineer in charge of concrete-steel design for the Hudson River Tunnel companies.

DATA FOR ELECTRIC DRIVES.—Manufacturers who plan the application of the motor drive to machines and machine tools are often at a loss because of the lack of information necessary to supply to the electrical manufacturer. The Northern Electrical Mfg. Company, Madison, Wis., offers to send prospective purchaser quotations on motors for application to machines and machine tool drive upon learning of the class of work to be accomplished and the voltage of the power circuit from which the current is to be taken. The Northern Company has had extensive experience in all kinds of manufacturing plants applying motor drive for increased output, and is usually able to determine upon the proper sort of motor equipment to be applied upon learning of the conditions.

THE NEW YORK TELEPHONE COMPANY is rapidly perfecting the details for its exhibit at the Madison Square electrical show. The space chosen by it is the circle in the center of the promenade, directly in the middle of the Garden. This circle is some 30 feet in diameter and over it will be hung an enormous blue bell covered with incandescent lights. This bell will be of the same bottom diameter as is the space, and will extend up almost to the roof of the Garden. In the booth itself there will be among other interesting exhibits a model telephone central. This central station will, like almost all the other exhibits in the Garden, be in use. Every exhibitor will have his telephone in his booth connected to this exchange, and during the show all the Garden business will be carried on through it. The same idea of making practical exhibits is being carried out very largely in the plans of those who have already signed contracts, and instead of being an unusual matter to find a working exhibit as is the case in most shows, it will in the case of the Garden Show be an unusual matter to find one that is not a working exhibit.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 3, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

800,619. REVERSIBLE GALVANIC BATTERY; Charles B. Askew, Chicago, Ill. App. filed Aug. 24, 1903.

800,625. INDUCTION COIL FOR IGNITING EXPLOSION MOTORS; Jules Carpentier, Paris, France. App. filed Feb. 8, 1905. In order to economize current, the coil is arranged to give only a single spark, whether the motor is run fast or slow. For this purpose an auxiliary coil of fine wire is shunted across the primary circuit, and serves to hold the interrupter armature attracted after its initial break.

800,638. STORAGE BATTERY; William Gardiner, Chicago, Ill. App. filed June 11, 1904.

800,653. METHOD OF AND APPARATUS FOR COMMUNICATING BETWEEN STATIONARY POINTS AND MOVING OBJECTS; Isidor Kitsee, Philadelphia, Pa. App. filed Feb. 8, 1902. A train telegraph system involving a single telegraph wire extending longitudinally between the track rails. The train carries a compass needle in proximity thereto, the movements of which, under the influence of induction from the wire, make and break a local relay circuit on the train.

800,654. AUTOMATICALLY STEERING MOVING OBJECTS; Isidor Kitsee, Philadelphia, Pa. App. filed Feb. 28, 1903. Particularly adapted for steering Whitehead torpedoes. A large compass needle is controlled by the earth's magnetism, and energizes one or another of a pair of solenoids, which operate the steering gear.

800,656. TELEGRAPHIC TRANSMITTING TAPE; Isidor Kitsee, Philadelphia, Pa. App. filed Jan. 19, 1905. A transmission code for automatic fast telegraph lines. The code is designed to give simple impulses of alterate polarity under all circumstances in order to avoid "choking" of the line. The dot is represented by a single impulse and the dash by two impulses which follow one another and are always of opposite polarity, whatever that may happen to be.

800,657. TELEPHONIC TRANSMISSION; Isidor Kitsee, Philadelphia, Pa. App. filed June 14, 1905.

800,658. SPACE TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed June 17, 1905. A wireless telegraph scheme adapted for moving trains. The antenna is carried by the train in the manner of a trolley pole, and a tappet on the track causes a motor to draw down the pole whenever a bridge or obstruction is passed.

800,675. TELEPHONE-RECEIVER; Hermann G. Pape, New York, N. Y. App. filed June 16, 1904.

800,677. SOUND-AUGMENTING RECEIVER; Hermann G. Pape, New York, N. Y. App. filed June 16, 1904.

800,747. KEY FOR TELEPHONE-SWITCHBOARDS; Frederick H. Loveridge, Chicago, Ill. App. filed Dec. 12, 1902.

800,755. CONNECTION SWITCH MEMBER; Frank R. McBerty, Evanston, Ill. App. filed Dec. 7, 1904. A mechanical construction of line wire support so arranged that a telephone instrument may be cut into the wire by a simple spring jack. The casing is formed with an integral hood which protects the contacts for the spring jacks.

800,756. PROTECTIVE APPARATUS FOR ELECTRICAL INSTRUMENTS; Frank R. McBerty, Evanston, Ill. App. filed Dec. 7, 1904.

800,762. TROLLEY POLE; Andrew L. Prentiss, Buffalo, N. Y. App. filed Oct. 18, 1904. A pneumatic retriever for trolley poles in which the valve which actuates the retrieving cylinder is controlled by a rod extending lengthwise through the pole. The harp is hinged to the pole so that its upward movement when the wheel leaves the wire, moves the rod and opens the retrieving valve.

800,767. TELEPHONE-TRANSMITTER; Philip J. Spies and Rudolph C. Deuben, Chicago, Ill. App. filed Nov. 1, 1902.

800,791. APPARATUS FOR PURIFYING WATER OR AGING LIQUIDS; Frederick K. Bowden, San Jose, Cal. App. filed June 5, 1905. Comprises a simple glass bottle with a platinum wire fused through the bottom thereof and a second wire forming the other electrode projecting through the cork.

800,792. THERMOMETRIC RHEOSTAT; William H. Bristol, New York, N. Y. App. filed Apr. 18, 1905. The resistance wire is hung within a mercury thermometer so that as the temperature rises, the mercury will short circuit and eventually totally cut out the resistance. The leads fused through the glass are of considerably larger cross section than the resistance, in order to avoid a burn-out or short circuit.

800,816. MOTOR CONTROLLER; Samuel S. Neu, New York, N. Y. App. filed Oct. 10, 1904. A system for economizing current for small motors, particularly where a large number are constantly in use as in factories.

It is customary to throw the armature current through series field windings to act as a magnetic brake in stopping the machines, a shunt winding being always in circuit from the mains. The present patentee has a cut-out in such shunt winding which operates automatically as soon as the motor has come to rest, so as to save exciting current when motor is not in action.

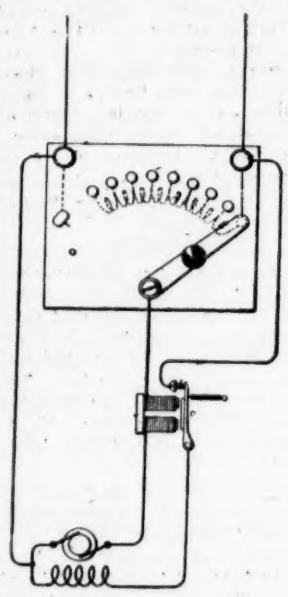
800,820. THERMAL CUT-OUT DEVICE; Charles A. Rolfe, Adrian, Mich. App. filed July 27, 1904. A spring jack switch is normally under tension to be withdrawn. It is retained in position by a wax plug having a thermal coil therein.

800,821. THERMAL CUT-OUT DEVICE; Charles A. Rolfe, Adrian, Mich. App. filed July 27, 1904. In this patent the same wax plug is used, but is disposed in a different relation with respect to the switch members.

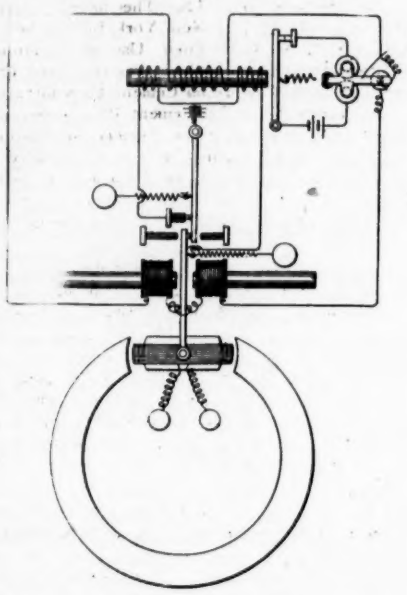
800,822. FUSE DEVICE; Charles Rolfe, Adrian, Mich. App. filed Jan. 20, 1902. A thermal cut-out for individual subscribers sets designed to be supported on the outside of the building. An insulating tube contains a fine wire fuse in series with the line circuit.

800,823. ELECTRICAL PROTECTIVE APPARATUS; Charles A. Rolfe, Adrian, Mich. App. filed Feb. 13, 1903. A thermal cut-out for individual subscribers sets having spring arms which tend to separate. They are held normally together by connecting piece having a detent. The detent is held rigid by a strip of solder which is melted under excessive current by a small filament of graphite.

800,824. ELECTRICAL CIRCUIT PROTECTIVE APPARATUS; Charles A. Rolfe, Adrian, Mich. App. filed Feb. 13, 1903. Involves practically the same construction, except duplicated so as to apply to a large number of circuits.



800,816.—Motor Controller.



800,844.—Quadruplex Telegraphy.

800,825. FUSE DEVICE; Charles A. Rolfe, Adrian, Mich. App. filed Feb. 13, 1903. Relates to details of the terminal connections of a fuse wire enclosed in a protecting tube.

800,826. ELECTRICAL CIRCUIT PROTECTOR; Charles A. Rolfe, Adrian, Mich. App. filed Feb. 13, 1903. Modifications of No. 800,823.

800,827. ELECTRICAL PROTECTIVE APPARATUS; Charles A. Rolfe, Adrian, Mich. App. filed May 18, 1903. Modifications of No. 800,824.

800,828. ELECTRICAL PROTECTIVE APPARATUS; Charles A. Rolfe, Adrian, Mich. App. filed May 18, 1903. Substantially like No. 800,823, except includes a lighting arrester formed of the usual carbon blocks separated by mica strips.

800,829. ELECTRICAL CIRCUIT PROTECTOR; Charles A. Rolfe, Adrian, Mich. App. filed Sept. 25, 1903. In order to make the thermal protector capable of resetting itself, the detent which holds the spring arms together is in the form of a star wheel positioned by a lump of solder. The wheel rotates to release the blades, but presents a new point for engagement with the spring blade when the solder cools.

800,830. ELECTRICAL CIRCUIT PROTECTOR; Charles A. Rolfe, Adrian, Mich. App. filed July 30, 1904. In this case the detent which holds the spring arms together yields when the solder melts to permit the separation of the arms, but is instantly repositioned by a supplemental spring.

800,831. ELECTRICAL PROTECTIVE DEVICE; Charles A. Rolfe, Adrian, Mich. App. filed Dec. 29, 1903. Modifications of the above.

800,832. ELECTRICAL PROTECTIVE DEVICE; Charles A. Rolfe, Adrian, Mich. App. filed Dec. 29, 1903. In this case a star wheel is used, but is normally held by a detent which is released by the fusion of the solder.

800,833. ELECTRICAL CIRCUIT PROTECTOR; Charles A. Rolfe, Adrian, Mich. App. filed July 28, 1904. Modifications of No. 800,830.

800,834. WEATHER TRAP FOR ELECTRIC WIRES; William H. Roney, Chicago, Ill. App. filed Nov. 3, 1904. A design for admitting high potential wires into buildings. The wire enters through an opening in the wall having a protecting hood, and is led upward through a horizontal insulating diaphragm within the hood.

800,843. CONTROLLING DEVICE FOR MOTOR VEHICLES; Victor E. Chamberlin, Indianapolis, Ind. App. filed Mar. 17, 1905. A controller designed to perform all the operations in an electric vehicle from a single lever adjacent to the driver's seat. Various positions of the lever operate the motor at varying speeds, set the magnetic brakes, or reverse, as desired.

800,844. QUADRUPLEX TELEGRAPHY; Stephen D. Field, Stockbridge, Mass. App. filed Aug. 20, 1904. The purpose of the invention is to avoid the fluttering or false signal which is caused by the reversal of the line current upon the neutral relay. The patentee cures the difficulty by so arranging the neutral relay that its armature must make a complete excursion, no matter how the line current varies after it has once started. For this purpose a supplemental coil is employed, which exerts a momentary inductive influence, urging the armature lever to complete its excursion and thereby perpetuate the signal intended.

800,854. WIRELESS TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Feb. 8, 1902. A detector for wireless telegraph systems in which a vibrating lever is arranged in a bath of water of such purity as to insulate local current, but form a free medium for the passage of the antenna current.

800,855. TELEPHONY; Isidor Kitsee, Philadelphia, Pa. App. filed June 30, 1904.

800,856. RECEIVING DEVICE FOR ELECTRIC TRANSMISSION; Isidor Kitsee, Philadelphia, Pa. App. filed June 14, 1905. Another form of detector in which a glass vessel containing ether or ether mixed with acetic ether has a heat coil including the antenna circuit fused therein. The expansion of the liquid by the heat coil raises its surface sufficiently to close a local circuit therethrough.

800,857. ELECTRIC FURNACE; Fredrik Adolf Kjellin, Saltsjöbaden, Stockholm, Sweden. App. filed July 6, 1905.

800,873. ELECTRICAL MEASURING INSTRUMENT; Edwin F. Northrup, Philadelphia, Pa. App. filed Nov. 19, 1904. A U-shaped permanent magnet of cast iron has a disc armature pivoted between its pole pieces which carries a pointer. The pointer projects upward through an opening in the upper pole piece, and indicates upon a scale thereon.

800,902. SYSTEM OF ELECTRICAL DISTRIBUTION; Rufus N. Chamberlain, Depew, N. Y. App. filed Jan. 12, 1904. A central station system involving generators, boosters and storage batteries for the purpose of maintaining a constant line potential regardless of the load. The booster has differentially acting energizing coils and a counter electro-motive force generator operates to resist the current through one of said coils.

800,907. ANTISEPTIC TELEPHONE MOUTHPIECE; William B. Curtis, San Francisco, Cal. App. filed Apr. 18, 1905.

800,909. CONTROLLER REGULATOR; Cyrus P. Ebersole, Keokuk, Iowa. App. filed July 23, 1902. The controller arm has a series of ratchet teeth and a detent which is successively moved out of engagement with the teeth by cams. The motion is sufficiently sluggish to prevent a too rapid motion of the controller.

800,916. HIGH POTENTIAL SWITCH; Edward M. Hewlett and William L. R. Emmet, Schenectady, N. Y. App. filed Jan. 15, 1900. The switch members depend horizontally from a supporting frame, and the oil bath tank is also hung from said frame so as to be readily removable for the inspection of the switch blades.

800,940. TELEPHONE-TRANSMITTER; Jerome Prince, Milford, Mass. App. filed Aug. 18, 1902.

800,946. POLARIZED ELECTRIC BELL; Samuel C. Shaffner, Mobile, Ala. App. filed July 15, 1903. A hollow magnetic coil has a permanent magnet pivoted to extend logitudinally therethrough, so as to be alternately deflected by an alternating current through the coil. The bell clapper is fixed to said permanent magnet.

800,984. PROCESS OF PURIFYING METALS; Henry M. Chance, Philadelphia, Pa. App. filed June 2, 1905.

800,993. TURN DOWN INCANDESCENT LAMP; Samuel E. Doane, Cleveland, O. App. filed Nov. 16, 1904. Relates particularly to a protecting plate or cap for the switch members of a turn-down lamp. The protecting cap acts as a sort of hood and allows the actuating cords to be pulled without producing any opening through which a shock may be obtained when the lamp is handled.

801,034. TELEPHONE-RECEIVER; William J. Murdock, Boston, Mass. App. filed Jan. 5, 1905.

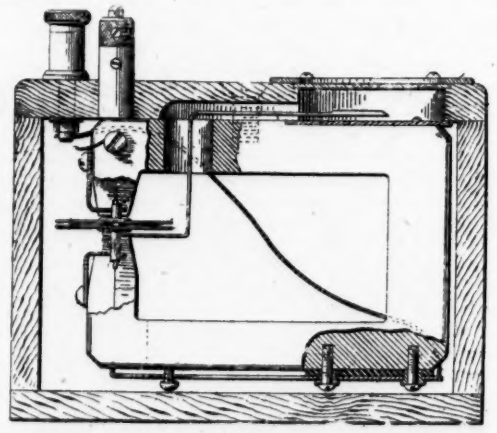
801,035. ELECTRIC BELL; William J. Murdock, Boston, Mass. App. filed July 21, 1904. Details of construction of a desk call bell in which the operating magnet is inset into the base and operates an armature which is connected to the hammer through a compound lever arrangement.

801,118. WIRELESS TELEGRAPH RECEIVER; Gustaf T. Swenson, San Pedro, Cal. App. filed Dec. 1, 1902. A detector for wireless telegraph systems in which a graphite brush bears against a shaft continuously rotated by clockwork. The antenna current bridges the microscopic gap for the local circuit, and the rotation destroys the bridge when the antenna current ceases. It has a pad to prevent vibration of the graphite brush.

801,130. TELEGRAPH AND TELEPHONE LINE AND THE LIKE; John C. Barclay, New York, N. Y. App. filed June 3, 1905.

801,132. ELECTRICAL MEANS FOR DETECTING AND ANNOUNCING CONTACT BETWEEN TWO CONDUCTING BODIES; Mark Barr, Kensington, England. App. filed May 31, 1901. A circuit is completed between the tool and the work holder when cutting contact is made, through a telephone receiver. The character of the sound indicates whether or not the tool is in proper cutting contact.

801,165. RAILWAY SIGNALING SYSTEM; Herbert B. Taylor, East Orange, N. J. App. filed May 15, 1905. Details of an overlap signal system having insulated track rail sections and a pair of magnets at each station which normally oppose one another, one of which is controlled by the adjacent section, and the other by the section ahead.



800,873.—Electrical Measuring Instrument.

801,173. PRINTING TELEGRAPH; John C. Barclay, New York. App. filed Mar. 18, 1905. (See Current News and Notes.)

801,180. CABINET FOR TRANSFORMERS USED IN X-RAY APPARATUS; Monroe S. Clawson, New York, N. Y. A form of casing for induction coils having a boxlike cover which fits over the coil and a base plate secured to the bottom thereof by non-metallic fastenings.

801,186. MAIN DISTRIBUTOR FOR TELEPHONE-EXCHANGES; Georg Deisenhofer, Munich, Germany. App. filed May 31, 1905.

801,190. ELECTRIC SEMAPHORE; Clayton E. Frederickson, Denver, Col. App. filed Jan. 23, 1905. Details of a semaphore arm operating mechanism. Detents for locking the semaphore arm in its raised position, and circuits for indicating to the tower house when it has been dropped to danger position.

801,196. SELF-LOCKING INSULATOR; Charles L. Mathian, Carlisle, Ky. App. filed Dec. 28, 1904. The insulator has an elongated hole extending transversely therethrough for the wire, and an inclined slot through which the wire is admitted. The inclination is such as to prevent the withdrawal of the wire when the insulator is in working position.